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Transactions on Maritime Science (ToMS) is a scientific journal with international peer review which publishes papers in the following areas:

~ Marine Engineering,
~ Navigation,
~ Safety Systems,
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~ Marine Information Systems,
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The journal is published in English both as an open access journal, and as a classic paper journal (in limited editions).

ToMS aims at presenting major maritime research all over the world, particularly focusing on the Mediterranean area. Articles will be double-blind reviewed by three reviewers. ToMS also promotes scientific collaboration with talented students at a beginning of their scientific careers. These papers also undergo strict peer reviews. Furthermore, the Journal publishes short reviews on significant papers, book reviews and workshops in the fields of maritime science.

The views and opinions expressed in the papers are those of individual authors, and not necessarily those of the ToMS editors. Therefore, each author will take responsibility for his or her contribution as presented in the paper.

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From Editor-in-Chief

Ivica Kuzmanić

Dear Readers,

I would first like to take the liberty, on behalf of my most esteemed colleagues and collaborators, as well as in my own name, of saying how proud I am due to the publication of the 14th issue of the international scientific journal ToMS ("Transactions on Maritime Science"), published by the Faculty of Maritime Science of the University of Split. As has been the case before, the papers have been submitted to three double-blind reviews, of which at least one from abroad, i.e. a country different from the one in which the author lives.

This issue can boast the largest number of papers so far – as many as eleven, as well as an impressive list of foreign authors, as many as ten. It brings eleven papers from several scientific areas: marine engineering, nautical science, safety at sea, commerce in ports, electronics, maritime medicine, as well as the ones aimed at improving and promoting ways and methods of teaching the English language to students. In any case, there is something for everyone interested in navigation, either at sea or rivers.

In the section entitled News we bring two papers. I would hereby particularly like to draw your attention to the tradition of preserving the building of historical boats in the villages of the Island of Murter which seems, regretfully, to be sinking into oblivion. We believe this effort to be the last defence line against such, undesired and undeserved, outcome.

The section also includes reports on various regattas, as well as a number of exhibitions and summer workshops.

The Croatian cultural heritage has by no means been omitted. We take exceptional pride in the fact that the poem hereby published is the work of Jakša Fiamengo. Born in 1946, he is a prize-winning poet from Komiža on the island of Vis, a distinguished member of the Croatian Academy of Science and Art, as well as the author of numerous texts and lyrics for popular music and Dalmatian klapa (*a capella*) songs. This poem has been set to music by Duško Tambača and performed by *Klapa Gusarica* of Komiža. This contribution is presented in a bilingual form in the striking translation by Mirna Čudić Žgela. Readers of the electronic edition can also listen to this outstanding performance.

We always remain in the hope that the papers we publish will encourage your cooperation.

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The Seaports of the Seine Axis Facing Contemporary Maritime Industry Mutations

Arnaud Serry

Maritime industry is constantly evolving and striving for increased innovation. Past years have been exceptionally interesting. Major trends like globalization and containerization have and continue to reshape the industry. These changes can be illustrated by strategic alliances between ship-owners trying to reshuffle circulatory and port maps. Thus, in its constant quest for optimization, maritime transport requires continuous modification of infrastructure. Due to the increasingly competitive environment, major seaports also tend to draw up new strategies to become more attractive. It represents a system of spatial and temporal interactions and the territorial implications of supply chains and transportation are not negligible. In this respect, the paper proposes to analyze a singular location: the Seine Axis. The axis is concentrating on its territory. It is France's leading port complex and the fourth largest in Europe. The area combines the maritime interface structured around the ports of the River Seine estuary with the metropolitan interface supplying the market of over 11 million inhabitants in the Ile-de-France region. This paper aims to qualify the port system of the Seine Valley in order to analyze the manner of its adaptation to recent, rapid and numerous changes in the contemporary maritime world. The paper will address the attractiveness and efficiency of ports in globalized economy, and the highly competitive European context. The paper is based on ports' statistics and in-depth bibliographical research. The paper will also integrate some results from the CIRMAR platform which is using the Automatic Identification System (AIS) to analyze maritime traffic.

KEY WORDS
~ Port
~ Seine Axis
~ Region
~ Maritime flows
~ Shipping

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1. INTRODUCTION

The seaports of the Seine axis (Le Havre, Rouen and Paris) are the main entry and exit gateways for the French international trade (Figure 1). Effectively, Le Havre is a global port and Paris a global city.

Le Havre, an estuary port, is capable of acommodating the largest ships and plays a major role in the French economy due to its importance and the diversity of its traffic. But for Paris and the "Ile-de-France" region, Antwerp or Rotterdam would do just as well. Due to being strong competitors of the Seine axis ports, the Northern range ports are constantly making a headway. Consequently, the Seine Axis ports face stiff competition from other ports in northwest Europe, such as Antwerp and Rotterdam. Despite good maritime connections, Le Havre is only a minor European hub, and its position in maritime networks has weakened over the last decade (Merk, 2011). In Europe, the ports of Le Havre and Marseille combined cannot even surpass the port of Antwerp, the second largest port in Europe. The French port complex, which nevertheless enjoys the benefits of an ideal location with exits on both the Atlantic and the Mediterranean, cannot fully exploit its location to attract the flow of goods (Vidil, 2015).

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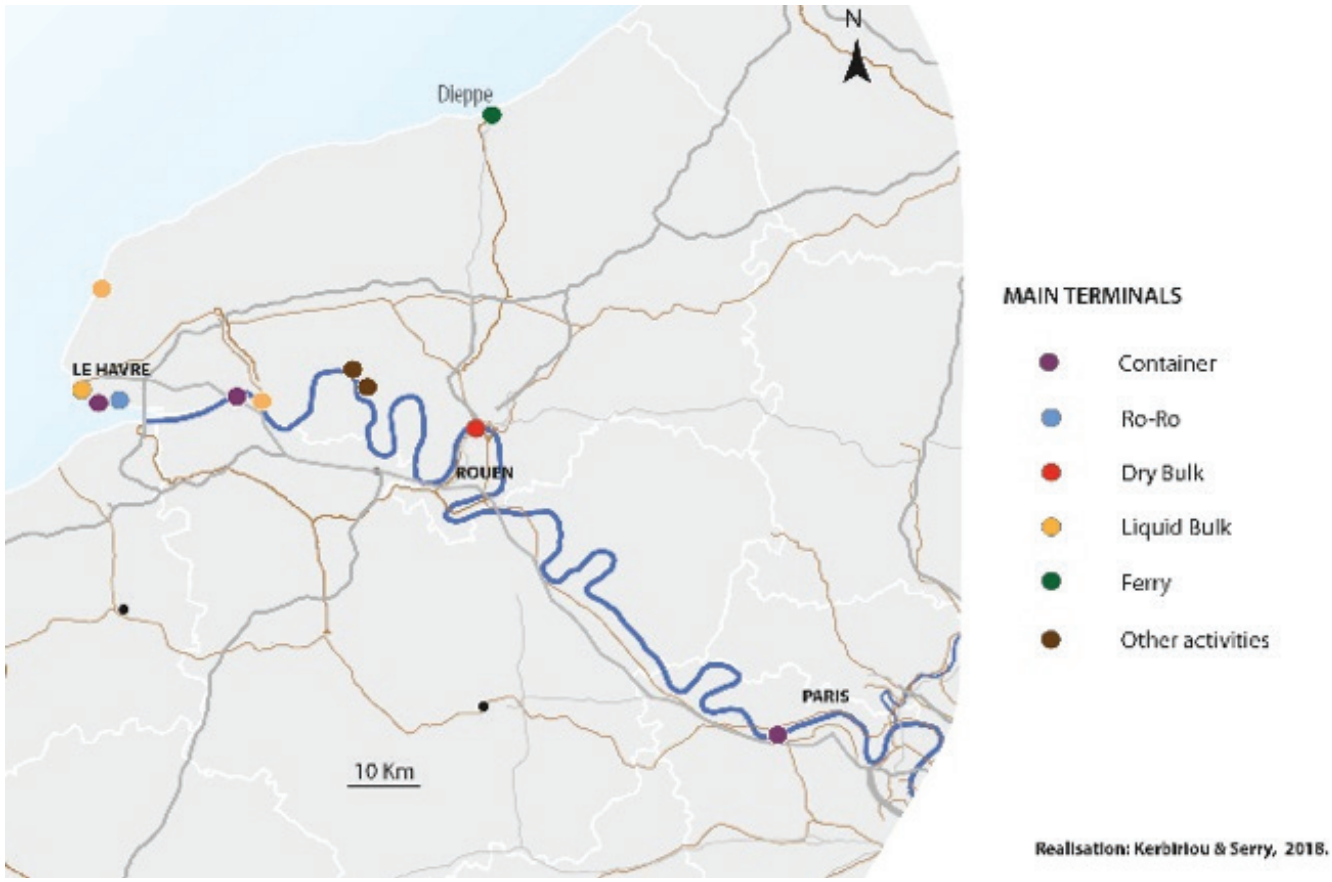

Figure 1.
The ports of the Seine Axis.

2. THE SEINE AXIS PORTS' ORGANIZATION

The term "Seine Axis" is increasingly used by developers, logistics professionals, politicians and academics, frequently to highlight the paradox between the potential and reality in terms of circulation of goods. The extended Paris region, also called *Greater Paris*, is a leading metropolis and represents a crossroads in Europe. It is linked to the world's major sea routes through the ports of Le Havre and Rouen at the end of the Seine route. However, this axis also appears in the contradictory context of a metropolis connected to a major traffic corridor in the form of a river, in which most of the traffic goes by road.

The Seine Axis has its own characteristics, culture and context but also potential for development:

- Firstly, it is a market of 25 million inhabitants. The Paris Basin, especially the Ile-de-France region, is fourth in the world in terms of GDP. Its commercial flows are partially captured by foreign ports like Antwerp and Zeebrugge. The Normandy region transports more than 12 million tons of goods to Ile-de-France compared with 30 million tons dispatched by Belgium;
- The river remains underused despite of a recent increase in traffic owing to the need to reduce CO_2 emissions, which has encouraged the development of a modal shift from roads to waterways;
- Another component of this potential is the position of the port of Le Havre: it is the first accessible port for goods entering and the last for goods leaving the northern range, which gives it an advantage in terms of transshipment to ports on Europe's Atlantic coast.
- Finally, port reconstruction has developed a new capacity for handling container flows: six million TEUs for Port 2000, adding to the existing capacity of the port (two million TEUs) and the industrial port area (Serry and Leveque, 2014).

There are 3 major ports in the Seine Axis: Le Havre, Rouen and Paris (Figure 1). These ports are quite different:

- Le Havre is the main seaport, the second largest French port by tonnage and the largest French port for containerized goods. It is also specialized in liquid bulk, in particular crude oil.

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Liquid bulk represented 65 % of its traffic in 2010; and 43 % of the total throughput in tones was crude oil, which represented only 15 % of throughput in northwest European ports on average. The secondary specialization of Le Havre is container traffic, although its specialization rate is in line with the average of northwest European ports (28 %) (Merk, 2011).

- Rouen is also a seaport but has a different role due to its location in the bottom of the estuary. Located at the mouth of the Seine, the terminals of port of Rouen in the Seine valley are in the vicinity of the Paris region. Its traffic is mainly dominated by grain (Figure 2). In 2017, with 9.1 Mt of grains exported, regardless of type, the port of Rouen had its best grain season ever.
- The port of Paris is a river port (19,84 Mt in 2017) in a big metropolitan area. It is the leading river port in France and the 2nd biggest in Europe after Duisburg. In fact, it is maintaining and handling the commercial operation of 70 sites in the region.

Figure 2.
Grain handling in Rouen.

The ports are largely complementary and the differences between them offer a potential for synergies. Le Havre has important hub functions for containerized cargo, Rouen is an important player in the niche market of agricultural products, while Paris serves its metropolitan market.

The domestic hinterland is hugely important since approx. 89 % of land transport flowing out of Le Havre is linked to France (Notteboom, 2012). The vicinity of a dense market is a condition for the development of the port's supply. According to the port of Le Havre, only 48 % of container traffic to and from Greater Paris in 2010 came from or went to the port of Le Havre; these figures were 51 % for the west of France. The port of Rouen has a marginal market share outside Normandy. According to the port of Paris, more than 80 % of its hinterland in 2010 was located in Ile-de-France and Normandy.

One major explanation for the limited size of hinterlands other than France is the dominance of HGVs in freight transport from Le Havre. Moreover, the modal share of container barge

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transport in ports is significantly lower than elsewhere: 9 % of TEU in Le Havre (32 % in Rotterdam and 33 % in Antwerp) (Lendjel and Fischman, 2012).

In fact the ports of the Seine Axis have difficulty promoting multimodal or combined transport solutions. The competitiveness of combined transport compared with road transport is also due to the commercial policy of combined transport operators. The involvement of the three main shipping lines, Maersk, MSC and CMA CGM in the implementation of waterway-road services on the Seine tended to improve the competitiveness of this mode of transport. In order for clients to shift from road to combined transport, prices must be 10 %-20 % lower (Frémont and Franc, 2010).

In reality, the comparatively weak port performance of Le Havre is connected to the gradual loss of its "natural hinterland" in France to foreign competitors. The geographical position of Le Havre is close to European concentrations of population and wealth, even if Antwerp, Rotterdam and some French port cities (Dunkirk and Calais) are better positioned (Chapelon, 2006). In general, the French hinterland is divided between its two large ports, Le Havre and Marseilles, but they are far from dominant. Foreign ports have managed to make considerable inroads in this area. The east of France is mostly serviced by Belgian ports (in particular Antwerp), whereas other regions in France can be considered the hinterland of Rotterdam and Barcelona (Guerrero, 2010). Antwerp and other northwestern European competitors transport more than 40 % of the tonnage expedited by French freight forwarders (Merk, 2011).

In reality, French ports are traditionally negatively perceived in several surveys on the preferences of port users. For instance, in a survey conducted by decision makers on port choice, comparing main ports in northwestern Europe, the port of Le Havre received relatively low scores. It scored particularly low on reliability and flexibility, due to the social instability created by trade unions and frequent strikes (Aronietis, 2010).

On the maritime side, the foreland of the port of Le Havre is globalized since it includes a significant number of ports located in major maritime facades like the US and especially Chinese coast. It is also the first port of call for the Northern Range, the main commercial interface between Europe and the rest of the world. The foreland of Le Havre port is not limited to this traditional pattern (Figure 3). Indeed, regular lines to South America are also highly developed

The port of Rouen, for its part, has a foreland that we can describe as regionalized or even "Atlantic" since the majority of weekly scheduled calls concern the West African coast and the Caribbean basin. Nevertheless, it is successfully integrated into the world's maritime networks through the practice of transhipment. Their maritime forelands are thus complementary.

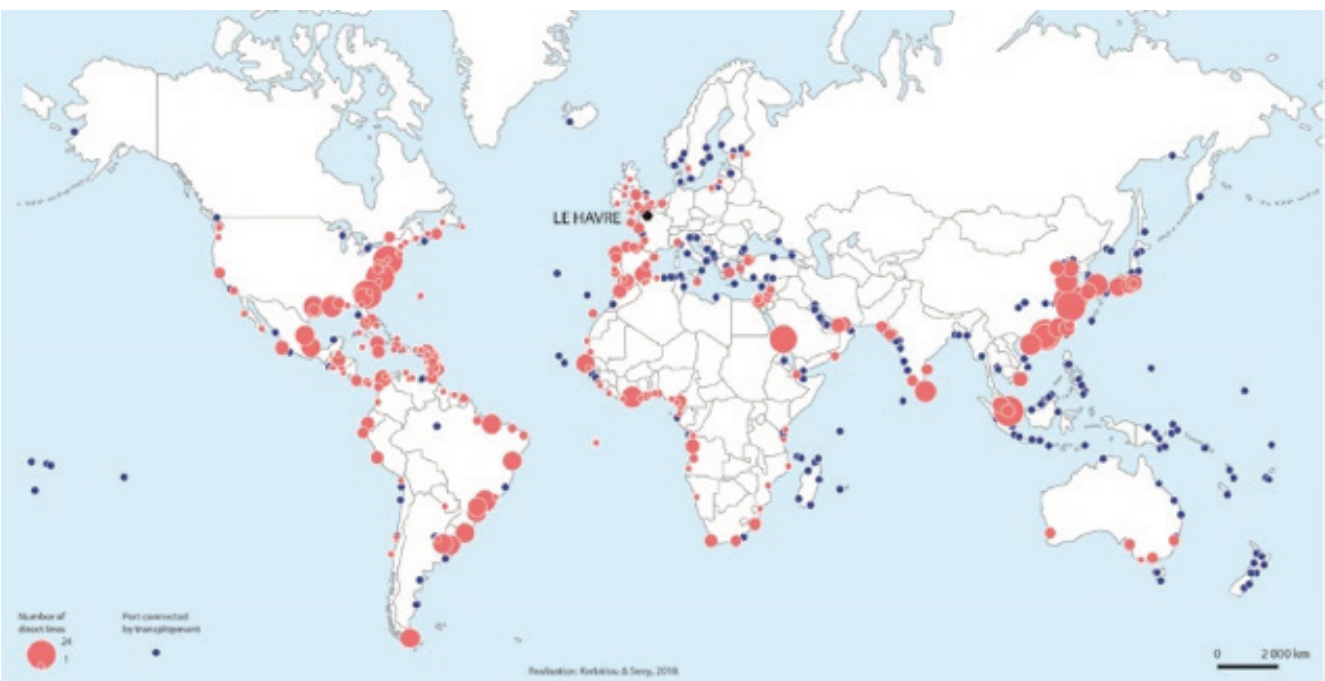

Figure 3.
Maritime foreland of Le Havre.

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3. FACING THE CONCURRENCY: THE RISK OF DROPPING OUT

In Europe, port activity is characterized by the concentration of traffic in several major ports, the "main ports", including the preponderance of Rotterdam and Antwerp. The main European ports are for the most part multifunctional ports, although there are exceptions, such as the ro-ro ports of the Straits (Calais, Dublin or Rostock), or the oil ports such as Milford Haven.

At the French level, the ports of the Seine Axis, with 92,6 Mt of traffic in 2017, are leaders and more resilient to the situation than Marseille (GPMM). But it is the challengers like Dunkerque who have proven to be the most dynamic. In fact, growth rates in the ports of the Seine Axis have been disappointing over the last decade, which has led to a decline in their market share.

The reality of statistics is cruel. In both the long and the short term, the port of Le Havre is on a downward slope in comparison with its main competitors in the North-European maritime range, the ports of the Golden Delta, principally Antwerp and Rotterdam, and the German ports of Hamburg and Bremen. For its total traffic, Le Havre's market share has been eroding since the 2000s. In 2012, Le Havre accounted for only 5.3 % of the traffic in North-Europe, in comparison with 7.5 % in 2000.

Each year has its explanation: for instance in 2012, the decline in crude oil traffic. But, since the 1970s, containers have been the engine of port expansion with growth rates of 7-8 % per year. Container traffic is less captive than bulk traffic. It depends on door-to-door intermodal transport chains that allow for the low-cost transportation of goods. To cope with this trend and the increasing size of ships, in 2006, Le Havre inaugurated "Port 2000" (Figure 4), a new port entirely dedicated to container traffic.

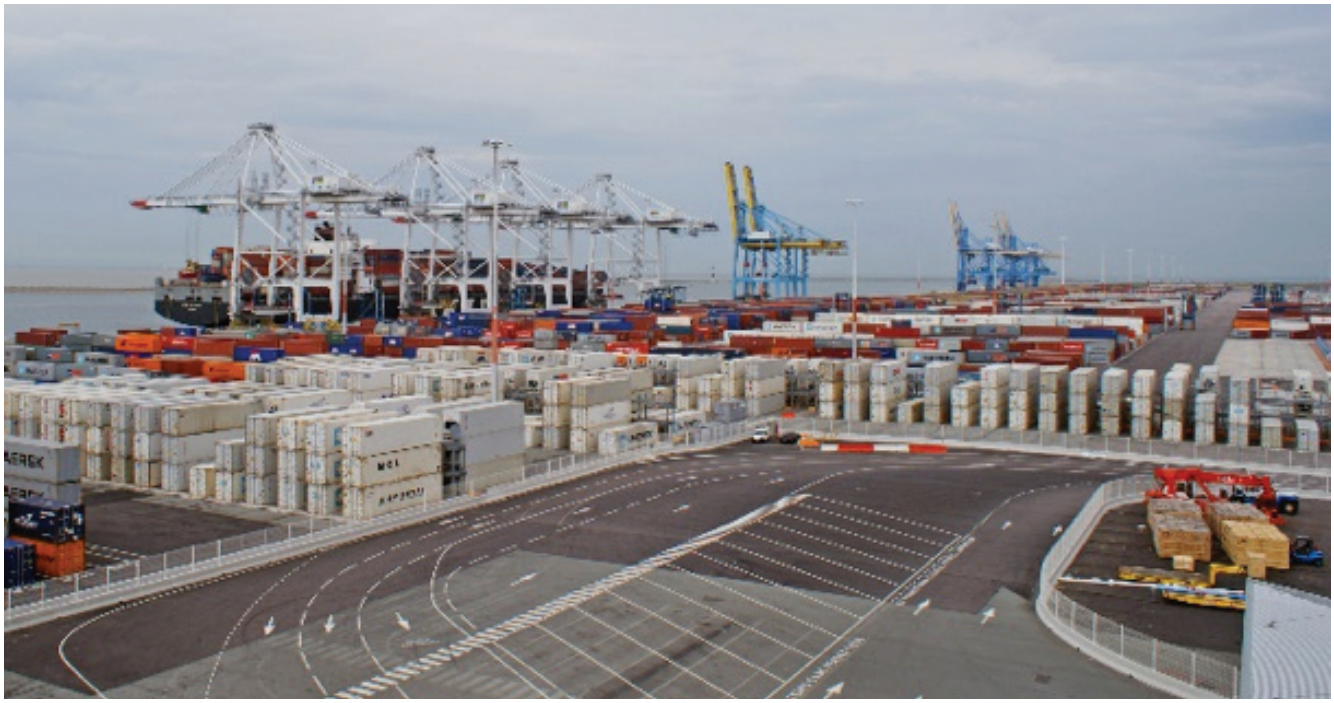

Figure 4.
Port 2000 in Le Havre.

In spite of over one billion euros of investment into traffic increase, it stagnates, while that of competitors continues to increase (Frémont, 2013). If in 2017, Le Havre's market share in the North-Europe row was 9 %, comparable to that of the early 1990s, 3.6 million twenty-foot equivalents (TEUs) would have been treated in Le Havre, compared with only 3 in fact. But, for container traffic, adaptation to international standards of port organization has been long and out of step with its competitors. Yet, it is essential for the loyalty of global shipping operators, ship-owners, cargo handlers, freight forwarders and shippers who mutually compete for ports.

The weaknesses can also be explained by hesitation to abandon the French-French system, powerful and coherent in its time but now lacking. To face this, the operating modes of France's ports were modernized in a July 2008 reform. The aim is to transition to the "landlord port" model. The objective of the

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2008 reform was to adapt French seaports to global and northern European competition (Cariou, 2014).

Another answer is that ports decided to gather their organization under one unique brand, with the ambition to compete with the biggest European hubs, in terms of capacity and performance; this new brand sustains commercial, environmental, territorial and institutional purposes. HAROPA, is the alliance of the port of Le Havre, the seaport of Rouen and the port of Paris. It was created in 2012 with the aim of forming a port system with an European dimension. So, HAROPA is an instrument at the service of the three major ports of the Seine Axis. Beyond the traditional assignment of port facility management, it seeks to promote a customer-oriented approach to improving the range of services necessary for developing industrial and logistic activities along the Seine Axis.

With a 6 % increase in overall seaborne trade and over 15 % in container traffic, HAROPA reported the best figures among North-European ports for the year 2017. For the first time in its history, it handled 3 million TEU of imports and exports in a single year, proof of its customers' confidence. This result is the fruit of an overall development of the logistics sector of HAROPA which combines paying special attention to the shipping offer, high-performance cargo transit, developing connected logistics zones and multimodal inland transport services. According to our estimations, its share increased from 5.86 % in 2011 to around 7 % in 2017, which is a 1.1 point increase.

With this in mind, we must not succumb to fantasies: the ports of the Seine Axis cannot take over the traffic of German or Golden Delta ports due to Europe's geography. The Rhine corridor is the center of gravity of the European economy, the location of main industrial and population concentrations in the EU. In the Rhine-Scheldt delta, where European distribution centers for brands and major retailers are located, a high proportion of container traffic is generated by the region surrounding the ports. Within two hours of road transport, the equivalent of 79 billion of GDP can be accessed from the port of Le Havre or Rouen. For an equivalent travel time, this value reaches 500 billion for Rotterdam and 640 for Antwerp. This reflects the differences in the location of ports in the Northwest range, i.e. the outlying position of HAROPA compared to the European backbone.

4. NEW CHALLENGES

4.1. New Shipping Industry Organization

When it comes to the adaptation of ports to contemporary economic changes, the central process concerns the allocation of port concessions for the operation of terminals. Since 2006, it has resulted in the domination of the three largest world armaments, the Danish Maersk Line, the Italian-Swiss MSC and the French CMA-CGM in the handling possibilities of Le Havre. They each have their own terminal in Port 2000. For Le Havre, their presence is an opportunity, provided it does not turn into an oligopoly of fact. Of course, their terminals are open to the customers of other companies. But the port did not choose to welcome, in addition to the three previous ones, another large international and generalist cargo handler able to guarantee total independence with regard to the customers and thus intensify the competition (Frémont, 2013). This question has become paramount with the emergence of new alliances between ship-owners in the spring of 2017.

Since the 1990s, shipping lines have been involved in container terminal operations to better control their business and squeezing costs. The new ocean carrier shipping alliances have been fully operational since April 2017 (Figure 5). These three carrier alliances account for nearly 80 % of global container trade and roughly 90 % of container capacity on major trade routes. With the carrier's market concentration, port competition will be strongly affected (El Kalla, Zec and Jugovic, 2017).

Maersk (including Hamburg Sud) and MSC have the combined capacity of about 6 million TEUs, i. e. approx. 33,4 % of the overall global market share in container capacity. For ports, the situation is nowadays complicated: if such an alliance does not choose to make their ships call to your port, the traffic can rapidly decrease. Moreover, these alliances are pragmatic arrangements, which means that their compositions change every few years.

Speaking of the Seine Axis, since April 2017 HAROPA has accommodated three alliances, "2M", "Ocean Alliance" and "The Alliance", grouping together all shipping lines on transatlantic and Asia-Europe trade routes. In addition, since "The Alliance" has just announced the arrival, in April 2018, of a new Asia-Europe service, making HAROPA the first port of call for importation, further traffic increase is expected. Today, on the Seine Axis, the waterway plays a marginal role in freight transport, as do the rail services. The dominance of road in freight transport is such that the waterways and the railways can only play a marginal role in Île-de-France. The growing strength of the multimodal terminal in Le Havre in 2017, with 145,000 TEU handled, is a support for the development of new rail and river services.

Of course, the mutations of the shipping industry also concerns technical aspects, like continuously growing container ships forcing ports to keep modifying their handling tools and processing capabilities. In the light of the increasing massification of containerized freight loads, and while the ultimate goal remains atomization (individual containers delivered to freight owners) (Rodrigue, 2017), the inclusion of ports in the transport system also depends on their integration in the multimodal land transport system.

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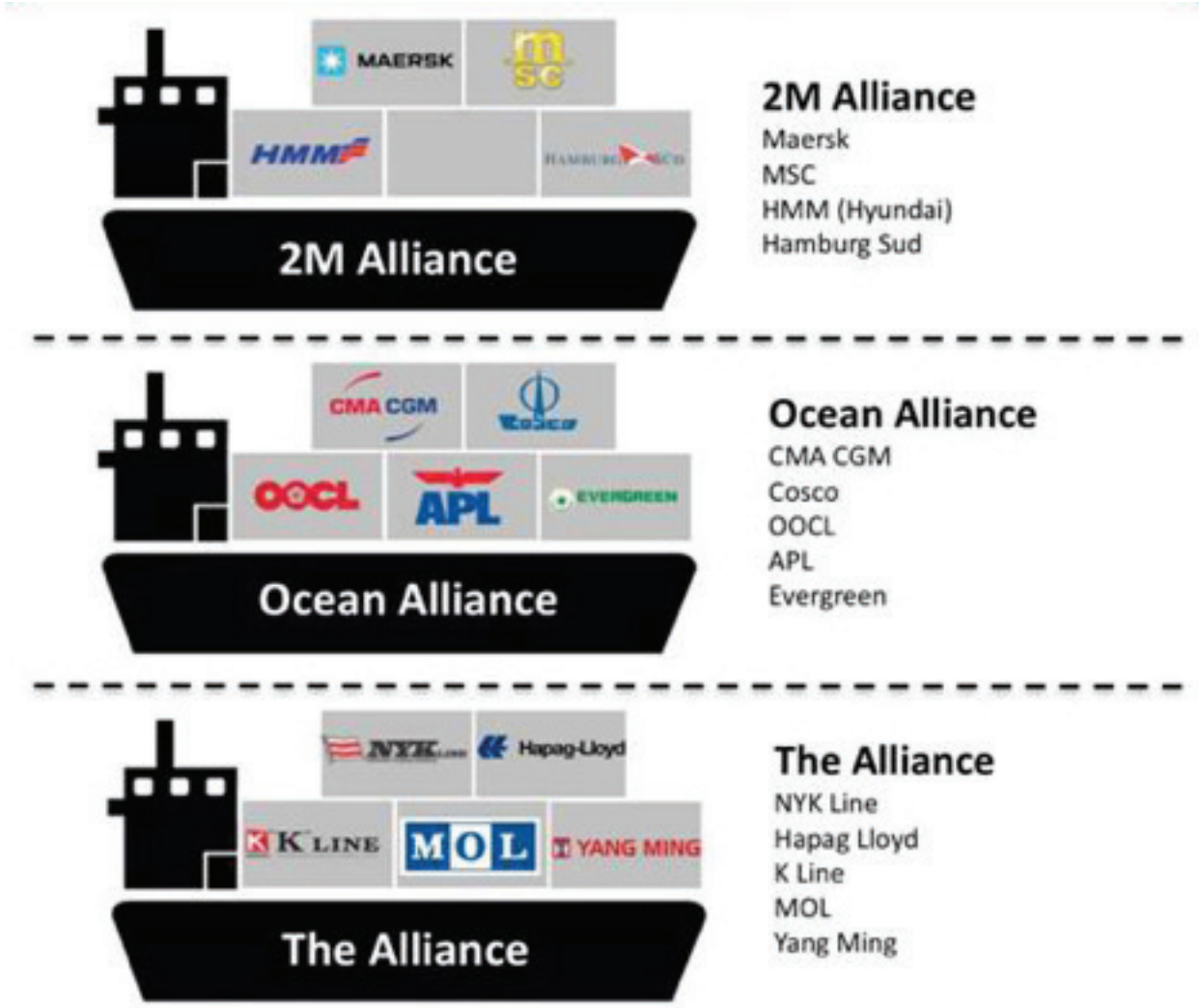

Figure 5.
New shipping alliances (Source: www.shipit.com).

In 2016, French ports were given special attention by the French government and parliament. Several proposals resulting from parliamentary reports should make French ports more competitive.

4.2. AIS Data to Understand

Being integrated into regular lines of different companies is very important for the ports, although it does not guarantee the capture of the flow of goods (Figure 6). On the basis of AIS data, we have, by simple calculations, determined the average share of containers handled by ships. Although this method needs further development, it can give, e.g. an interesting overview of the importance of a port's hinterland. The CIRMAR platform, used to explode and analyze large databases – the so called big data – yields unavoidable and tremendous results (Kerbiriou et al., 2017).

Therefore, AIS data were used to obtain some interesting results about port calls in the North Range in 2016. Rotterdam is the port with the highest number of calls, with 14,483 container ship stops in 2016, far ahead of Antwerp (4,470) and Le Havre (2,274).

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Figure 6.
Ports calls and handled containers in the Northern Range in 2016.

The importance of transhipment in a port has a strong impact on the number of stopovers. This is highlighted when the average size of container ships is analyzed. Port of Rotterdam, which carries large transhipment traffic to the United Kingdom and by river barges, receives units with an average size of 2,446 TEU, while Le Havre accommodates units over 6,000 TEU. Large ships on intercontinental shipping lines call at Le Havre but feedering services seem to be very rare in the Seine Axis ports. Their weaknesses are underdeveloped transshipment traffic and relative maladjustment to shipping companies' strategies.

In addition, when average loading and unloading rates of container ships per port are compared, only 18 % of containers are loaded / unloaded in Le Havre, compared to 65 % of the total quantity of TEU in Hamburg or 46 % in Antwerp.

Data analysis gives us an overview of the operational and strategic reality orchestrated by the major global shipping lines. In the context of transshipment, calls of giant containerships to the port of Le Havre are two to three times less important in terms of volume than in Rotterdam. On the one hand, Le Havre always takes advantage of its unique geographical position of the first port of call and the last output port of the North-European economic area. On the other hand, Le Havre suffers from the short sea shipping network. Short distance shuttle feeders do not cover all the coastal areas from the Portuguese Algarve to the Northern British markets. Furthermore, and without detailed analysis, it is worth recalling the reality of the hinterland and multimodal drainage capabilities that complement giant container ship stopover volumes. The Seine Axis system seeks to densify its volumetric imports and exports data via land-based multimodal strategies to counter the "logistical diversions" traffic orchestrated by the Antwerp and Rotterdam port communities.

5. CONCLUSION

The performance of the Seine Axis ports is riddled with paradoxes. It has been lagging, but the ports have great assets, such as well-developed infrastructure and nautical access (in the case of Le Havre), which could be turned into decisive competitive advantages. Recent reforms have removed some obstacles and brought port governance in line with European practice. But the Seine Axis ports are operating in a very competitive environment, contending with ports such as Antwerp and Rotterdam that have managed to capture parts of the French hinterland.

Challenges are still numerous for the ports of the Seine Axis. The quality of infrastructure, the willingness to massify flows and logistics development are at the heart of the strategy of port

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development in the North of Europe. French ports must get closer to these models so that all the actors of these maritime and shipping sectors can fully play their role in developing wealth and employment.

Economic actors have a role to play if the Seine Axis ports' system is to modernize and become more competitive, but they can't do anything without the support of real political will. There is room for innovation both at the infrastructural level, and at the level of regulations which still create artificial barriers likely to impede development. The full potential of the French transport network must be exploited to develop these ports at such a privileged geographical location.

After an exceptional year of 2017 and six years since its establishment, the HAROPA has become the leading French port system. If strong integration trends expressed by the French Prime Minister are realized, some change is anticipated in 2018. Figures and ambition prove that HAROPA meets all the conditions to keep growing, at the service of its customers in 2018.

6. ACKNOWLEDGMENTS

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Estimation of Forces Acting on a Sailboat Using a Kinematic Sensor

Alan Mahne Kalin, Dejan Žagar, Peter Vidmar

Amateur keel boat racing has become increasingly popular in coastal regions with a long sailing tradition, such as the Adriatic. Although the traditional experience is transferred to new generations of skippers and crews that compete in national and international regattas with open class boats, the material limits of the boat are often measured subjectively, by sail or mast failure, and transferred through a story. Most sailors know why a component failed, but often they do not know what force was needed for the particular failure. Forces acting on a boat are usually estimated with CFD and towing tank experiment for relevant sailing conditions, but full scale data in seaway are rarely taken. Here we want to show a low budget method to get a rough estimate of aerodynamic and hydrodynamic forces acting on a keel sailboat using a kinematic sensor. Some approximations are taken into account to construct a simplified mathematical sailboat model, which allow to relate kinematic data to forces acting on the sail, hull, keel, and rudder. Some data such as the geometry and mass distribution of the boat has to be known; other parameters such as water resistance instead has to be experimentally measured. The results of a series of measurements are presented and discussed. Looking on the limitations of such a method, a proposal for a new sensor is made.

KEY WORDS
~ Sailing boat
~ Inverse dynamic
~ Broach
~ Forces
~ Kinematic sensor

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1. INTRODUCTION

An inverse dynamic approach was attempted to evaluate the forces and moments acting on a sailboat while underway. The sailboat is a 10m inshore racer Evolution 10 designed by Andrej Justin. Forces and torques arising from the weather effects on hull, keel, rudder, and sails were modelled based on experimental measuring and empirical equations. The input data to the model has been later taken measuring kinematic and rudder position.

The obtained data depends heavily on the weather conditions and crew reactions. Also, in controlled conditions repeated experiments will give different measurements. In such an approach, there are many kinds of errors to take into account when working out the solution.

For simplicity's sake, an indexing system will be used to depict the forces, torques and arms: the first index reveals the nature, the second reveals the axis.

Two coordinate systems are used: inertial and body-fixed. The inertial system is fixed: the origin coincides with the first measured position on the water level, axis 4 is toward north, 5 is toward west, and 6 completes the right-hand system toward zenith (up). The body coordinate system is fixed to the sailboat: the origin coincides with the boat's center of gravity (CG), axis 1 is toward bow parallel to the design water plane, axis 2 is toward port side parallel to the design water plane, and axis 3 completes the right-hand system.

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Table 1.
Indexing system.

First index	Nature	Second index	axis
1	Wind effect on sails	1	Body-x
2	Water effect on hull	2	Body-y
3	Water effect on keel	3	Body-z
4	Water effect on rudder	4	Inertial-North
5	Sea waves effect on hull	5	Inertial-West
		6	Inertial-Up

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1.1. Equations of Motion

Equations of motion expressed for the body coordinate system are:

$$\sum_{i=1}^{5} F_{i,j} = m a_j \quad j=1,3 \tag{1}$$

$$\sum_{i=1}^{5} T_{i,j} = I_{j,k}\,\alpha_k + \Omega_{j,k}\,I_{k,m}\,\omega_m \quad j=1,3 \tag{2}$$

where $F_{i,j}$, m, a_j, $\tau_{i,j}$, $I_{k,m}$, α_j, ω_j and $\Omega_{j,k}$ are external forces due to i acting along j, mass, linear acceleration, external torque due to i acting along j, mass inertia matrix, angular acceleration, angular velocity and angular velocity skew symmetric operator respectively.

The linear and angular acceleration and velocities were measured by the motion tracking device (MT) that was fixed off the body CG. Such offset gives rise to a centrifugal term due to angular velocity and a tangential acceleration term due to angular acceleration. The maximum calculated value for centrifugal term and tangential acceleration term was 0.02m/s^2, and 0.2m/s^2 respectively, where the sensor noise level was 0.15m/s^2. For this reason, these two terms were neglected.

1.2. Modelling the Inertia Matrix

The geometry of the boat was measured while docking, picking various point coordinates on the hull and the appendages. The points where then plotted in CAD software and a surface was fitted to them. The deck and main interior structures were also designed, and then an area inertia matrix was calculated from the software for each component (surface). A surface density was assigned to each component to get a mass inertia matrix.

The exact surface density of the boat was not known for each part, so an experimental measurement was done to estimate the $I_{1,1}$ and then surface density was manually assigned to the CAD model to fit the measured values of $I_{1,1}$ while keeping the CG of the assembly at the origin. The inertia matrix was then calculated for all the other terms using the surface density distribution.

The experiment to estimate $I_{1,1}$ was performed as a damped oscillation around axis 1. The following analytical solution was fitted to the results obtained from MT

$$\Phi_1(t) = A e^{(-\beta t)} \cos(\omega_1 t - \varphi) + d \tag{3}$$

to get the amplitude A, damping β, damped angular frequency ω_1, phase offset φ and roll offset d of roll respect to time $\Phi_1(t)$. If neutral axis of the body are aligned with body coordinate system, then $I_{1,1}$ is related to the previous parameters through

$$I_{1,1} = \frac{k\,m\,g}{\omega^2_1 + \beta^2} \tag{4}$$

where k is the first derivative of righting arm with respect to the roll angle in the linear region near zero. The results of the fit are shown in the following Figure 1.

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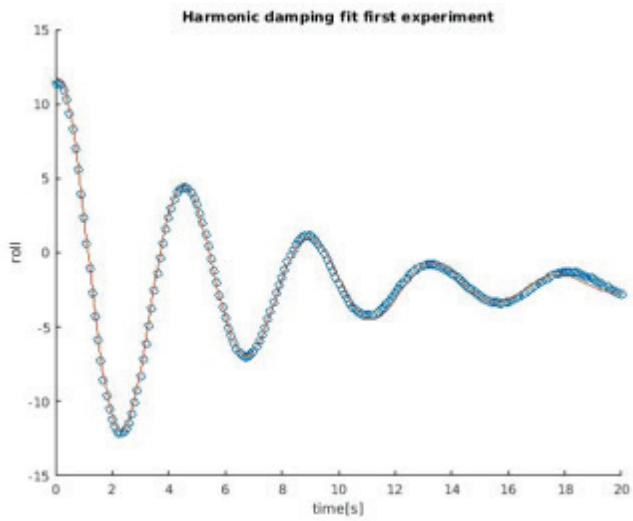

Figure 1.
Experimental measurements of harmonic damping (12/01/2018) – roll angle expressed in degrees

1.3. Hull Water Resistance Model

Hull resistance was measured by towing and stopping experiments. The towing experiment was performed using a dynamometer placed between the boat's mast and the towing line, towing the boat at speeds up to 15kts. The stopping experiment was performed towing the boat to approximately 7kts and measuring the velocity profile while stopping after the towing line release. All the measurements were taken in calm seas with no real wind, for several headings.

Boat's resistance is assumed to be composed of parasitic drag (form drag, skin friction and interference drag), wave drag, and lift induced drag. Parasitic drag was modeled using the square law

$$F_{R1}(v_1) = -a(v_1)\, v_1^2 \tag{5}$$

the wave drag was modeled using the analytical solution from (Fitzpatrick, 2018).

$$F_{R2}(v_1) = -b\left[\frac{\sin(\pi - Fr^{-2})}{\pi - Fr^{-2}}\,\frac{1}{1+\pi Fr^{-2}}\right]^2 \tag{6}$$

where Fr is the Froude number $F_r = \dfrac{v1}{\sqrt{gl}}$

v_1 is the linear velocity along the axis 1, g is gravitational acceleration, and l is the length of the waterline.

Together the analytic equation fitted to measured data is (Mahne Kalin, 2014)

$$F_{2,1}(v_1) = -a(v_1)\, v_1^2 - b\left[\frac{\sin(\pi - Fr^{-2})}{\pi - Fr^{-2}}\,\frac{1}{1+\pi Fr^{-2}}\right]^2 \tag{7}$$

where

$$a(v_1) = 43.3 - 2.705\left(\frac{\pi}{2} + \arctan\left(\frac{v1 - 4.62}{3.79}\right)\right) + 13.05\left(\frac{\pi}{2} + \arctan\left(\frac{v1 - 3.94}{0.75}\right)\right) \tag{8}$$

and

$$b = 3990 \tag{9}$$

1.4. Keel and Rudder Models

To check the feasibility, two approaches were taken to model keel and rudder.

The first approach uses lift and drag coefficients based on potential fluid dynamic program that are freely available on the internet. Those have been computed for 2D profiles and a correction is needed to account for the induced drag due to the finite length of the profile.

The second approach uses an empirical formula shown in (Larsson, Eliasson and Orych, 2014). It was developed based on data from several tank tests.

The program uses the first approach to model the keel and rudder, while the second approach is used for comparison.

The first method

Lift and drag coefficients were taken from the data table available on (AirFoil Tools, 2018). The profiles in question are NACA 0012 for the rudder and NACA 63015A for the keel. The coefficients are calculated for 2D geometry, so 3D effects, such as the induced drag, have to be accounted for.

The coefficients are tabulated in the program, and an interpolation function is used to get the desired value of the angle of attack (AOA).

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The corrections used to calculate the 3D lift are:

$$C_{L3D} = C_{L2D}\left(\frac{AR}{AR+2}\right) \tag{10}$$

$$C_{D3D} = C_{D2D}\left(\frac{C^{2}_{L2D}}{\pi AR}\right) \tag{11}$$

where C_{L2D} and C_{D2D} are the two-dimensional lift and drag coefficients respectively, and AR is the aspect ratio.

Finally, the forces due to the rudder and keel are:

$$F_{3,2} = 0.5\rho V^{2} A_{k}\left(\cos(\beta) C_{k,L3D} + \sin(\beta) C_{k,D3D}\right) \tag{12}$$

$$F_{4,2} = 0.5\rho V^{2} A_{r}\left(\cos(\beta) C_{r,L3D} + \sin(\beta) C_{r,D3D}\right) \tag{13}$$

The second method

The derivative of the lift coefficient for small angles is defined by:

$$\frac{dC_{L}}{d_{\alpha}} = \frac{5.7 \cdot AR_{e}}{1.8 + \cos(\Delta) \cdot \sqrt{\left(\frac{AR^{2}_{e}}{\cos^{4}(\Delta)} + 4\right)}} \tag{14}$$

$$AR_{e} = 2 \cdot AR \tag{15}$$

$$\alpha_{k} = \beta \tag{16}$$

$$\alpha_{r} = \beta - \varepsilon + \delta_{r} \tag{17}$$

$$\varepsilon = 0.136 \cdot \left(\frac{C_{L,K}}{AR_{e,k}}\right)^{0,5} \tag{18}$$

where AR is the aspect ratio of the fin, Λ is the sweep angle; β, α_{k}, α_{r} and δ_{r} are leeway angles, AOA of the keel, AOA of the rudder and rudder angle respectively, all expressed in radians. The index k and r stand for the keel and rudder respectively. The integral of the equation (14) is

$$C_{L} = \frac{5.7 \cdot AR_{e}}{1.8 + \cos(\Delta) \cdot \sqrt{\left(\frac{AR^{2}_{e}}{\cos^{4}(\Delta)} + 4\right)}} \cdot \alpha \tag{19}$$

The lift coefficients are multiplied by the dynamic pressure and the respective planform area.

$$L_{k} = C_{L,k} \cdot 0.5 \cdot \rho \cdot V^{2} \cdot A_{k} \tag{20}$$

$$L_{r} = C_{L,r} \cdot 0.5 \cdot \rho \cdot (0.9 \cdot V)^{2} \cdot A_{r} \tag{21}$$

Note that for the rudder case only 90 % of the water velocity is accounted due to the keel interference.

The hydrodynamic side force:

$$F_{3,2} = L_{k} \cdot c_{hull} \cdot c_{heel} \tag{22}$$

$$F_{4,2} = L_{r} \cdot c_{hull} \cdot c_{heel} \tag{23}$$

$$c_{hull} = 1{,}8 \cdot \left(\frac{T_{c}}{T_{k}}\right) + 1 \tag{24}$$

$$c_{heel} = 1 - 0{,}382 \cdot \Phi \tag{25}$$

where Φ is the roll angle in radians, T_{c} is the draft of the canoe, and T_{k} is the draft of the keel.

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The angle of attack for the keel is the leeway angle, while for the rudder the change in the flow direction due to the keel is considered as well as the rudder angle.

Here, the hydrodynamic side force was calculated directly from the lift, using small angle approximation.

1.5. Hydrostatic Model

For the present purpose, the hydrostatic is the main source of torque. Hydrostatic torque acts around the axes 1 and 2.

Torque around the axis 1 can be estimated knowing the roll angle and crew weight distribution. During the measurements, only 3 crew members were on board and were assigned a fixed position from which a correction was calculated to get the true righting arm. The models used in the program to get the righting moment are based on the geometry and mass distribution for a discrete set of rolling positions. As required by the program, the value of righting arm is interpolated from previously calculated data.

Torque around the axis 2 is very difficult to estimate, as a small change in pitch requires a relatively big amount of torque, and the changes in pitch are comparable with the MT error in estimating the pitch. Therefore, the analysis driven by this data would be chaotic and has been replaced by a holonomic constraint

$$\Phi_2(t) = 0 \tag{26}$$

The torque necessary to fulfill the equation of motion was assigned to this constraint, appearing as $\tau_{2,2}$. This may seem straightforward, but transforming the torque vector from the boat to the inertial coordinate system $\tau_{2,2}$ acts also as a weather helm when the boat is heeled. This can be a major cause that can provoke a broach.

Hydrostatic forces in calm seas are oriented positively along the axis 6, while weight force due to gravity is always oriented downwards. Assuming calm seas, the two forces are always equal and opposite, so they are discarded from the analysis.

2. MEASUREMENTS

All the forces and torques have to fulfill the equations of motions at all times. The "known" forces and torques arise from the models that are incomplete or at least not always correct. There are factors that can be missing in the modelling process, so there must be space for error.

The data given by the MT are also subject to error that can be intrinsic in the device or due to internal estimate errors. The MT used to get the present data is Xsens MTI/g. It measures directly 3D accelerations, angular velocities, magnetic field orientation and position from the GPS. Raw data are then filtered through a special extended Kalman filter to get the orientation and velocity data in real time. Velocity and orientation are estimated values and it has been noted that they can be delayed with respect to raw data[1]. Due to slow changes in the dynamic, a 10Hz sampling filtered was chosen.

Based on these observations, we opted to derive the angular velocity and acceleration from the filtered position and linear acceleration from the filtered velocity.

2.1. Time Derivatives of Rotation Matrix and Velocity

Rotation matrix is formed from Tait-Bryant angles, given as output data from the MT, using the following equation:

$$R = R_3 R_2 R_1 \tag{27}$$

where

$$R_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\Phi_1) & -\sin(\Phi_1) \\ 0 & \sin(\Phi_1) & \cos(\Phi_1) \end{bmatrix}$$

$$R_2 = \begin{bmatrix} \cos(\Phi_2) & 0 & \sin(\Phi_2) \\ 0 & 1 & 0 \\ -\sin(\Phi_2) & 0 & \cos(\Phi_2) \end{bmatrix}$$

$$R_3 = \begin{bmatrix} \cos(\Phi_3) & -\sin(\Phi_3) & 0 \\ \sin(\Phi_3) & \cos(\Phi_3) & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

and Φ_i is the rotation angle around the axis i. The rotation matrix R is an operator that rotates a vector expressed in inertial frame to body frame. The time derivative of rotation matrix is

$$\dot{R} = R\,\Omega \tag{28}$$

1. *It has been observed during damped oscillation that tangential acceleration is delayed from orientation. This delay can give rise to errors if we use velocity derivative and acceleration interchangeably.*

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from which the components of the skew symmetric operator Ω can be taken. These are the components of angular velocity vector expressed in body frame *(ω)*. Numerical derivative has been taken with central difference scheme.

Having the angular velocity vector, the angular acceleration vector has been taken using the central difference scheme.

Before each derivation, a moving average filter with window of 0.5 seconds was applied to the data to avoid the spreading of errors due to noise.

The acceleration was calculated taking the numerical derivative with central difference scheme to velocity, which was filtered using a moving average filter with window of 0.5 seconds.

2.2. Summary of Forces and Torques

At this point the kinematic data of the boat are known; some forces have been modeled using kinematic data, and some are unknown. The following equation represents the known or modeled terms on the right hand side and the unknown on the left hand side.

$$F_{1,j} + F_{5,j} = -\sum_{i=2}^{4} F_{i,j} + ma_j \qquad j=1,3 \tag{29}$$

$$\tau_{1,j} + \tau_{5,j} = -\sum_{i=2}^{4} \tau_{i,j} + I_{j,k}\, a_k \qquad j=1,3 \tag{30}$$

As it is, this system has 6 equations and 12 unknowns, so some assumptions have to be made to solve the problem. The last term of the right hand side describes the changing of momentum, and it will be bigger for sudden changes.

The two unknown forces and torques are due to the wind and waves. These two phenomena can be located by the frequency of their changes. Wind changes with a very low frequency with respect to waves. This means that by grouping the two phenomena together the high frequencies can be attributed to waves, and the low frequency can be attributed to sail.

Taking the difference to the limit, we assumed that the sail forces are nearly constant or, in other words, that the measured kinematic term arising due to a change of sail forces only is usually so low that its detection using the MT is comparable to noise level. Assuming this, all the dynamic part can be attributed to the waves and we can rewrite the equations in

$$F_{1,j} = -\sum_{i=2}^{4} F_{i,j} \qquad j=1,3 \tag{31}$$

$$F_{5,j} = ma_j \qquad j=1,3 \tag{32}$$

$$\tau_{1,j} = -\sum_{i=2}^{4} \tau_{i,j} \qquad j=1,3 \tag{33}$$

$$\tau_{5,j} = I_{j,k}\, a_k \qquad j=1,3 \tag{34}$$

The equations (32) and (34) can be solved directly; the equation (31) can also be solved directly, but the accuracy of estimating $F_{1,j}$ is very important as it appears also in the related torque. The equation (34) in its component form runs as follows:

$$-d_{1,3} F_{1,2} = d_{3,3} F_{3,2} + d_{4,3} F_{4,2} - \tau_{2,1} \tag{35}$$

$$\tau_{2,2} + d_{1,3} F_{1,1} = -d_{3,3} F_{3,1} - d_{4,3} F_{4,1} \tag{36}$$

$$\tau_{2,2} \tan(\Phi_1) + d_{1,1} F_{1,2} = -d_{3,1} F_{3,2} - d_{4,1} F_{4,2} \tag{37}$$

Here, the assumption has been taken that all the arms producing the required torques lies on the x-z plane, and that sail, rudder, and keel forces' vectors lie in the x-y plane only. This assumption is reasonable mainly when hoisting jib, genoa or main sail, which are flat and produce no vertical lift. This will not be the case for spinnaker like sails, whose vertical lift is known to help rising the bow from the water.

The equations (35) to (37) have been arranged so that all the unknown terms lie on the left hand side.

If we use the results from the equation (31) in the equations (35), (36) and (37), the only unknowns are $\tau_{2,2}$, $d_{1,1}$, and $d_{1,3}$.

$\tau_{2,2}$ appears in both equations because the holonomic constraint that prevents changing in pitch acts horizontally in the inertial system, which has to be properly transformed when expressing in body frame. To be clearer, the same torque vector in the inertial frame has components

$$q = R_3 \begin{bmatrix} 0 \\ \sqrt{\tau_{2,2}^{\,2} + (\tau_{2,2} \tan(\Phi_1))^2} \\ 0 \end{bmatrix} \tag{38}$$

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2.3. Two Ways to Solve the Same System

Bearing in mind that the modeled forces are subject to error deriving from non-universality of the model, the system can be solved in two ways (later referred to as methods A and B):

- Assuming the location of the center of effort of sail $d_{1,1}$ and $d_{1,3}$, and then solving for $F_{1,1}$ and $F_{1,2}$. (A)
- Calculating $F_{1,1}$ and $F_{1,2}$, and then solving for $d_{1,1}$ and $d_{1,3}$. (B)

Both methods give a solution and they can be compared; however, they have been found to be very different in some particular cases.

For the rule-of-thumb, the center of effort of sails lies approximately one quarter forward of the geometric center of the area of both sails. At the same time, it has to lie also on the sail projected area. These two conditions can be checked continuously creating a proper fuzzy set.

Direct calculation of $F_{1,1}$ and $F_{1,2}$ (method B) can lead to errors because of the difficulty in estimating the angle of attack (AOA) acting on the keel and the rudder, as the decisive factor in the keel and rudder force model.

2.4. Estimation of AOA

The MT measures the magnetic heading and the velocity over ground. These two measurements are derived independently as the MT does not assume any constraint. The AOA of keel can be estimated only by taking the horizontal angle between unit vectors of velocity and heading. Such method is prone to errors arising from the drift and magnetic variations.

The AOA of rudder is simply assumed to be AOA of keel plus the rudder angle, taking positive when the boat tends to turn right at forward speed.

Note that method A neglects the measured AOA of the keel and implies a calculated one. The calculation of the implied AOA of the keel also requires to take into account the rudder angle. As the solution is not analytically solvable, a Newton-Rhapson method was used to find the proper value of AOA of the keel.

To estimate the accuracy of such a measurement, we computed the required angle of attack to solve for method A. The explanation and comments of the results of such a comparison are expressed in the next section.

3. RESULTS

A comparison between the required and actual AOA of keel was made using methods A and B. They do not agree, and there are more explanations to this.

The required AOA based on this procedure is too low with respect to the one expected: the boat was sailing windward at an angle to the real wind of approximately 45 degrees in fresh air. During the measurements, the time averaged roll angle was 25 degrees. The weather helm was felt on the tiller and the visual expectation of the leeward angle was around 5-8 degrees. The calculations based on the measurements through method A for the same time interval gave an average value of AOA of keel of 3 degrees. This result seems wrong. The calculation was repeated with a simplified model, and the result was nearly the same. That points to the fact that either the hydrostatic, keel and rudder models, or both are wrong. Based on many tries, the error resides in the keel and rudder force estimation models, which seems not to be appropriate for this sailboat.

3.1. Proposal for a New Sensor

The weakness of this approach lies in the estimation of the AOA of the water hitting the rudder and the keel. The AOA, however, can vary with the depth along the keel because of the interference with the hull. The rudder is also subject to the interference from the keel preceding it. Such interference was modeled in (Larsson, Eliasson and Orych, 2014)The comparison of the present model and the model from (Larsson, Eliasson, & Orych, 2014) solving by method A gives very similar results.

A cheap sensor for measuring the AOA on the keel would measure the leeway angle, and its design would be very similar to those used for the wind direction. A more sophisticated (and expensive) version is the directional ultrasound sensor which gives the water flow vector.

Following a series of measurements with the leeway angle sensor, it would be possible to create an ad-hoc expression that evaluates the sail forces. To validate the models, the measurements have to involve also an appropriate direct force measurement on the sail rig and sheet attachments, using strain gauges.

3.2. Space for Improvement

The inputs necessary to estimate the sail forces and torques in calm seas are:

1. roll angle
2. leeway angle
3. speed through the water
4. rudder angle

They can all be obtained from relatively cheap sensors.

A redundancy input would be the wind speed and wind angle that can be taken from anemometers found on many sailboats. This redundancy input can be used through an algorithm to estimate whether the sudden changes are due to wind, waves or crew movements.

Using the calculated values $F_{1,2}$, and guessed values for $d_{1,3}$ in the torque balance equation (35) will return a residual, which can be attributed to crew righting moment.

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Taking the measure of pitch and water pressure distribution on stations along the boat length allows to derive the hydrostatic moment and forces related to pitch by integration. This approach would allow to eliminate the holonomic constraint and to evaluate also the propulsive force deriving from surfing the waves[2].

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2. *When buoyancy force is not acting vertically up.*

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Framing Stakeholder Involvement in Sustainable Port Planning

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This paper presents a framework to encompass stakeholder involvement in port planning processes, by specifically focusing on long-term strategic plans aimed at sustainability and designed to satisfy the needs of a port community and its surroundings. A classification of the main port stakeholders is presented together with some traditional and non-conventional tools and methods that can be used to support the participation process, according to the degree of participation and the steps of the plan. This analysis takes its clue from the results of the EU PORTA project, aimed at setting a new system of guidelines to integrate regional planning and port management. Port authorities and local policy-makers can use the output of this analysis to understand how to deal with the complexity of multi-actor decisions in port planning. By duly taking into consideration stakeholders' needs and concerns it will be easier to find the most shared solutions pursuing port sustainability.

KEY WORDS
~ Public participation
~ Port-City relationship
~ Participatory Planning
~ Stakeholder management

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1. INTRODUCTION

Sustainable development of ports relies on an appropriate planning and management of ports, balancing environmental, social, and economic interests through mediation and open dialogue (Wakeman, 1996). Globalization of production and consumption has induced structural changes in the inter-port/intra-port relations (Olivier and Slack, 2006). In order to guarantee the success of a port, port managers should succeed in managing the different stakeholders and interactions among them (Henesey et al., 2003). In this respect, if on one hand ports play a strategic role in the development of domestic and international trade, on the other they can have a strong impact on the livability of the local community hosting the port (Ignaccolo et al., 2013-A). For these reasons, port planning requires appropriate skills and procedures to be successful. Port planning has moved from a top-down approach (i.e. exclusively taking into account the 'strategic intent' of the port authority) to a bottom-up approach (i.e. taking into account the 'strategic intent' of different stakeholder categories, in addition to the strategic intent of the port authority) (Dooms et al., 2004). Therefore, it is important to involve all the stakeholders from the very beginning of the planning process, with different levels of involvement during the planning phases. Port community is very complex and articulated, with a lot of decision bodies and stakeholders with often conflicting objectives and interests. In this direction, port community systems have been emerging as electronic platforms for information exchange between public and private agents making available logistical information[1]. The participatory approach is quite recent in transport planning (Cascetta et al., 2015; Le Pira et al., 2018), while it is well established for land use planning (Arnstein, 1969). The European Union encourages the Member States to adopt Sustainable Urban Mobility Plans (SUMPs), fostering cooperation across different policy areas and sectors, across different levels of government and administration,

1. *See, e.g., http://www.valenciaportpcs.com/en/.*

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and in cooperation with citizens and other stakeholders. In port areas, the relationship between urban planning and port planning becomes fundamental to foster a joint sustainable development.

This paper presents a framework to encompass stakeholder involvement in the port planning processes by specifically focusing on port action plans (PAPs), i.e. long-term strategic plans focused on specific measures aimed at sustainability targets, based on the cyclical principle of Plan-Do-Check-Act. The remainder of the paper is organized as follows. Section 2 will present a succinct literature review on concepts and methodologies to involve stakeholders in sustainable port planning. Section 3 will present the methodology, by introducing the EU PORTA project, which inspired this research (3.1), the concept of PAPs (3.2), and a framework to include stakeholder involvement in PAPs (3.3). Section 4 will end the paper with the main conclusions and practical implications of the analysis performed.

2. LITERATURE REVIEW

The concept of "stakeholder" has been evolving from the first definition by Freeman (1984) ("any group or individual who can affect or is affected by the achievement of the organization's objectives"). Transport stakeholders are generically defined as "people and organizations who hold a stake in a particular issue, even though they have no formal role in the decision-making process" (Cascetta et al., 2015).

Identifying all the relevant stakeholders to involve in a decision-making process is not trivial. Decision context plays a fundamental role in understanding who the relevant actors are; therefore, a good knowledge of it is required (Le Pira, 2015). Some authors classify stakeholders on the basis of the type of interest they have in a plan/project: "primary stakeholders" are those who have a direct interest in the decision (e.g., transport operators or transport users), while "secondary stakeholders" are the ones who have an indirect interest (e.g. local communities) (Cascetta and Pagliara, 2013). They can also be categorized into three classes (Le Pira et al. 2016): experts (i.e. key informants), general stakeholders (e.g. institutions, groups, environmental associations, transport companies), and citizens (singles or in groups). While experts have high competence but low stake, stakeholders have competence and high stake, and citizens have low competence but act in the public interest.

For what concerns port planning and management, a first distinction should be made between internal stakeholders, who are part of the comprehensive port management, and external stakeholders, i.e. *in situ* and *ex situ* economic players (Notteboom and Winkelmans, 2002). They can be in turn categorized into: (1) institutions and authorities (public sector); (2) companies and operators (private sector); (3) local communities (or community stakeholders) (Ignaccolo et al., 2013-A). In Italy, an important role is played by the port management committee, a structure internal to the Port Authority, composed of members from local, regional, and maritime authorities, in charge of approving the port plans and the authorizations to operate inside the port[2].

Several conflicts can arise among the different stakeholders. Port expansion is fundamental for port authorities to cope with market opportunities in the foreland-hinterland continuum, but can be hampered by external stakeholders (e.g. environmental pressure groups). In general, port policy should foster traditional micro-economic goals for port industries and operators, while central government usually pursues socio-economic objectives, aimed at an increase of the societal value-added of the national seaport system (Notteboom and Winkelmans, 2002).

Due to the variety of interests and objectives of each stakeholder, it is important to use appropriate methods and tools to support the participatory process. A review of typical tools and methods that can be used according to the characteristics of the process, e.g. degree of interaction, group size, time, and money needed, can be found in (Johnson and Dagg, 2003).

Besides, it is important to define the desired level of involvement, according to the well-known "ladder of citizen participation" (Arnstein, 1969). In transport planning, it is possible to identify five levels, according to the phases of the planning process (Cascetta and Pagliara, 2013), i.e.:

- Stakeholder identification, at the early stage of decision-making context assessment;
- Listening, during the analysis of the present situation and the identification of plan objectives;
- Information giving and consultation, while formulating and evaluating the alternative systems' projects;
- Participation, in the final choice.

Stakeholder mapping is a useful way to categorize stakeholders and understand their role/influence in the decision-making process (Aerts et al. 2015). In this respect, Social Network Analysis can be used to investigate social structures and to shorten the process of analyzing stakeholders (Le Pira et al., 2017-A). Stakeholders are the nodes of a network and are linked with the others according to their relationships (e.g. collaboration, information, competition). Stakeholder influence can be studied via indicators of centrality, according to their position and role in the network (Ignaccolo et al., 2013-A). The analysis could be further enhanced by studying how the flow of information and communication exchange among stakeholders could influence the outcome of a participation process oriented toward consensus building. In this respect, simulation models and, in particular, agent-based models (ABM), have been used in

2. *Italian National Law 84/94 titled „Riordino della legislazione in materia portuale" modified by D.Lgs. 169/2016. Available at: http://www.gazzettaufficiale.it/eli/id/2016/08/31/16G00182/sg.*

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the transport planning domain to explore the opinion dynamics in stakeholder networks, allowing the investigation of the role of network topology and other variables in reaching a shared decision (Ignaccolo et al., 2013-A; Le Pira et al. 2016; Le Pira et al., 2017-B). In the field of port planning and management, ABM have been used, e.g. to reproduce port container terminal management, simulating stakeholders' relations for the analysis of operational policies for sustainable port and terminal management (Henesey et al., 2003).

Together with the methods that can be useful in a preliminary phase to carry out stakeholder analysis, appropriate decision-supporting methods and procedures have to be employed to develop effective participation processes (Le Pira et al., 2017-A). As an example, multi-criteria decision-making (MCDM) methods have been used in port planning and management to elicit stakeholder preferences, e.g. for alternative projects, according to multiple criteria of judgment (see, e.g. Dooms et al. (2004), Gonzalez-Urango and García-Melón, 2017).

All these methods can be used to support a participation process according to the desired degree of participation and the step of the planning process. However, recent findings show that, in general, actual stakeholder management practices convey moderate resemblance to the methods and theoretical findings presented in academic stakeholder management literature (Aerts et al. 2015).

Besides, it can be argued that some standardization of public involvement would be advantageous in port planning and management, e.g. with reference to environmental impact assessments of proposals for coastal development (Johnson and Dagg, 2003).

In what follows, a procedure to involve stakeholders in the long-term strategic planning of a port is presented, with the aims to bridge the gap between theory and practice of stakeholder involvement in port planning, and to support port management bodies in taking well thought out and shared decisions.

3. METHODOLOGY

3.1. Background: the PORTA Project

The EU PORTA[3] project (PORTs as a gateway for Access inner regions), supported by the European Regional Development Fund within the MED Program, aimed to define and implement common strategies and integrated transport/land use planning procedures for increasing the role of ports as strategic key actors of the maritime and logistics development and as gateways to access inner regions.

3. *http://www.programmemed.eu/en/the-projects/project-database/results/view/single.html?no_cache=1&idProject=121*.

The consortium, composed of academic, industrial, consultants and port authorities from Spain, France, Italy, Greece and Slovenia, proposed a new planning approach to overcome the dichotomy between maritime and transport policies and urban/local sustainable development of the areas surroundings the ports.

One of the outputs of the proposed port planning system consists of a "Guide on Port Action Plan" (PORTA, 2013). Its scope is to provide guidelines to port stakeholders and local authorities for the preparation and implementation of a "Port Action Plan" (PAP). The aim of a PAP is to integrate maritime policies in the port system with the process of land use/transport planning in the coastal regions.

In the following, the rationale behind the use of PAPs is presented.

3.2. Port Action Plans (PAPs)

A PAP is a strategic plan designed to satisfy the needs of a port community and their surroundings for a better quality of life. It has a long-term, planned horizon of 10 years, at least. It identifies problems and solutions to enhance the efficiency and sustainability of the port systems and relevant surrounding area (PORTA, 2013). It builds on existing planning practices and takes into proper consideration the integration with other planning sectors, public participation, and evaluation principles.

Typical objectives of a PAP are to:

- Decongest the maritime system bottleneck by coordinating transport modal shift policies;
- Limit pollution produced by the increased mobility of goods in coastal regions, especially when the emissions of trailer and semitrailer trucks are produced within the urban nodes to arrive to the harbor terminals;
- Promote intermodality solutions in urban seaports in order to boost the transfer traffic shares from unimodal road transport to Short Sea Shipping and combined transport;
- Enhance the accessibility of ports towards their hinterland and the home markets, so that maritime regions can economically benefit from the plan strategies.

The planning process is inspired by the principle of the Deming Cycle Plan-Do-Check-Act (PDCA) (Deming, 1950), an iterative four-step problem-solving model used to ensure continuous improvement of processes and optimal use of available resources, consisting of the following phases:

- Plan, i.e. setting up the objectives and actions necessary to deliver the expected results;
- Do, i.e. providing adequate resources and responsibilities to implement the actions;
- Check, i.e. adopting a monitoring system to measure the distance between the targets and performances;

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- Act, i.e. taking corrective actions to adjust the previous steps following the logic of continuous improvement.

The planning architecture is based on three hierarchic levels (Figure 1):

1. Strategic lines, which refer to global objectives that are relevant for the evaluation of the economic, social and environmental impacts of the plan;
2. Actions, which refer to specific objectives and evaluation of the results of the plan;
3. Operative measures, which refer to operational objectives and evaluation of the outputs of the plan.

A PAP is not a static picture of what the future of the port area is expected to be, but it is meant as a dynamic process subject to continuous monitoring and evaluation. According to this, it is important to identify global, specific and operational objectives that can be assessed respectively via: (1) impact indicators, to monitor the sustainability of the whole plan; (2) result indicators, to evaluate the performance of the actions of the plan; (3) output indicators, to monitor the implementation of the operative measures, which made up each action of the plan. Consequently, a PAP is not a list of operative measures without relations; on the contrary, it is composed of a series of actions, made up by several operative measures, and jointly converge towards strategic lines for economic, social, and environmental sustainable development of port systems (Ignaccolo et al., 2013-B).

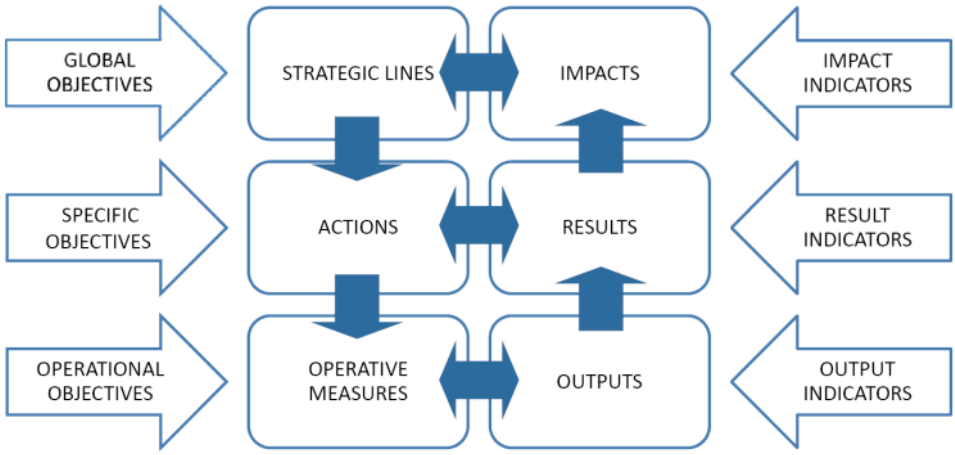

Figure 1.
PAP planning model (Source: Ignaccolo et al., 2013-B).

A PAP is composed of the following steps:

- P – Plan
  - Territorial ambit of reference
  - Stakeholder and Community Involvement
  - Analysis of the state of the art
  - SWOT analysis
  - Scenario Analysis
  - Analysis of the best practices and choice of the plan proposal
- P – Do
  - Implementation of the operative measures, actions and strategic lines
- C – Check
  - Monitoring the plan
- A – Act
  - Revision and re-assessment of the plan.

The University of Catania (Italy), as partner of the PORTA project, investigated the issue of public participation of the diverse stakeholders involved in the preparation of a PAP, and in particular the relationships between Port Authority and city/citizens. Drawing from this experience, a framework to involve stakeholders in PAP processes is presented.

3.3. Framing Stakeholder Involvement in PAPs

According to the proposed planning model and the different levels of involvement described in section 2, it is possible to frame stakeholder involvement in the steps of a PAP, as reported in Figure 2 and described below.

The first step of the planning process is to delimit the portion of territory where the impacts of the port system extend more directly their influence (territorial ambit of study),

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which is wider than the planning port area where the planning organization has the power to decide interventions (territorial ambit of intervention).

The territorial ambit of reference will give the input for the next phase of "Stakeholder and Community Involvement", mainly aimed at identifying the main stakeholders and plan the participation process. Involvement of citizens, public information and consultation with stakeholders should be taken into account from the very beginning of the formation of a PAP, in order to ensure maximum transparency and, consequently, social acceptability and improvement of the image of the port. The analysis of the state of the art is essential to provide a baseline against which any improvement can be measures. The main aims of this step are to: (1) gather all relevant data on the status quo of traffic, port activities and existing planning documents; (2) identify potential vulnerable elements (communities, health, environment, water quality, coastal areas, mobility issue, infrastructure, etc.); (3) prepare a baseline, together with key stakeholders, to identify and prioritize key problems to be addressed by the plan. In this phase, listening of stakeholder main concerns, together with information giving about the plan, are fundamental.

The SWOT analysis is a strategic planning tool used to evaluate the strengths, weakness, opportunities, and threats of a project (Ignaccolo et al., 2017). Both the "Analysis of the state of the art" and the "Scenario Analysis" described later on can benefit from this technique based on the building of a matrix with a critical reading of the port system. It consists of the identification of its strengths and weaknesses (endogenous factors), and the opportunities and threats that characterize its context (exogenous factors). Stakeholder consultation is of utmost importance to have a clear insight into the reality of the port system, the main critical issues to be solved, and the potential for its development. This will give the input to set up the objectives,

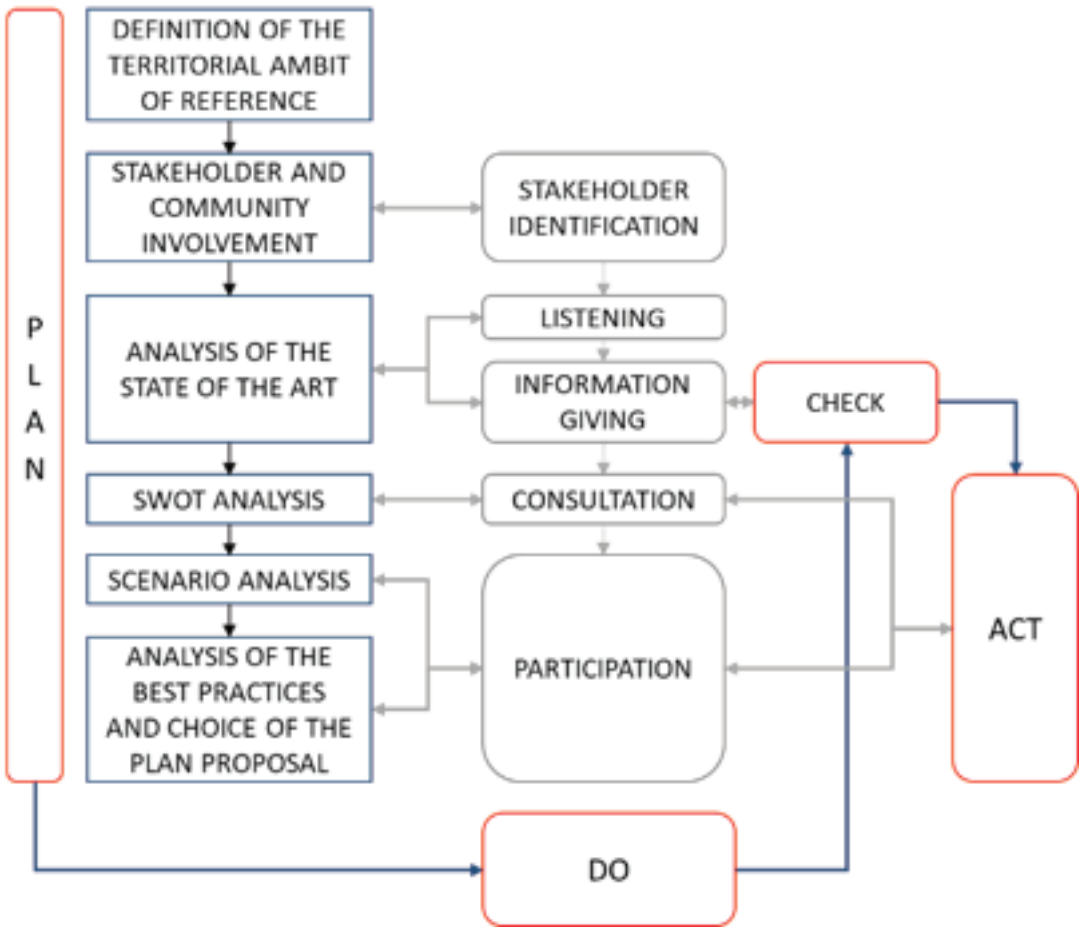

Figure 2.
Framework of stakeholder involvement in PAP process (Source: arranged from Ignacolo et al., 2013).

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indicators and actions necessary to deliver the expected results as described in Figure 1.

After developing the "do-nothing" scenario by predicting exogenous trends in the absence of any action, and the "business-as-usual" scenario which provides the implementation of the actions already programmed, a set of "alternative scenarios" resulting from different alternative policies and choices has to be analyzed. Scenario analysis is performed by comparing the effects of the different scenarios via a set of indicators. This is done by involving all relevant stakeholders to discuss the impact of alternative planning policies and make them participate in the evaluation process. To this aim, it is important to keep the results understandable for non-technicians. Appropriate techniques, mainly based on quantitative models, such as those described in section 2, have to be put in place to choose which strategy serves the community vision in the most effective way.

In the last step of the "Plan" phase, a package of effective actions is selected by actively asking the participation of stakeholders also in the choice of result indicators and targets that allow monitoring of progress towards the specific and general objectives already shared. This step can benefit from the lessons learnt from the best practices, widely available from databases of European projects, taking into account their pertinence with the sustainability objectives to be realized and their degree of transferability within different contexts.

Stakeholder involvement should be assured also in the "Check" and "Act" phases of the Deming cycle, i.e. by respectively (a) keeping them informed on the monitoring system and process set up to measure the distance between targets and performances, and (b) involving them so to take corrective actions to adjust the previous steps following the logic of continuous improvement.

Table 1 resumes the PAP steps with the related levels of stakeholder involvement and methods and tools suggested for each step, based on the literature review performed in section 2.

In this respect, stakeholder mapping and social network analysis can be used in the first phase of "stakeholder identification", to have a clear insight on the actors to involve and their role in the decision-making process.

Informative workshops and individual interviews are well suited for listening and information giving purposes, while focus groups on specific topics, involving small stakeholder groups (Le Pira et al., 2017-A), are more appropriate to consult them and have a clear insight into the reality of the port system.

Scenario analysis with stakeholders could benefit from the use of quantitative methods, such as (group) multi-criteria decision-making (MCDM) methods, to elicit their preferences toward specific objectives and strategies.

Consensus conferences are necessary to reach a convergence of opinions toward a shared plan (Le Pira, 2015). In this respect, starting from the results of stakeholder mapping and social network analysis, agent-based models can be used to analyze the conditions that would likely lead to consensus building in a network of stakeholders, thus helping to carry out effective consensus meetings.

Public meetings can be organized to inform stakeholders about the monitoring process, while focus groups and workshops, also in this case supported by the use of MCDM methods, are more suitable to revise and reassess the plan.

Table 1.
Framing stakeholder involvement in PAPs.

PDCA phase	PAP Phase	Level of involvement	Suggested methods
P	Territorial ambit of reference	-	-
P	Stakeholder and Community Involvement	Stakeholder identification	Stakeholder mapping, social network analysis
P	Analysis of the state of the art	Listening, Information giving	Workshops, interviews
P	SWOT analysis	Consultation	Focus groups
P	Scenario Analysis	Participation	Workshops + MCDM methods
P	Analysis of the best practices and choice of the plan proposal	Participation	Consensus conferences + ABM
D	Implementation of the operative measures, actions and strategic lines	-	-
C	Monitoring of the Plan	Information giving	Public meetings
A	Revision and re-assessment of the plan	Consultation, Participation	Focus groups, workshops + MCDM methods

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4. DISCUSSION AND CONCLUSION

Stakeholder involvement and management is becoming fundamental to guarantee an appropriate and sustainable development of ports. This paper presented a framework to encompass stakeholder involvement in port planning, by proposing different levels of involvement in the decision-making process, and suggesting methods to support it. The focus of the analysis is on port action plans, i.e. long-term strategic plans aimed at sustainability and based on the logic of the Plan-Do-Check-Act cycle.

Some of the methods proposed are techniques or practical tools to help conducting effective participation processes (i.e. workshops, interviews, focus groups, consensus meeting, public meeting, workshops with the use of MCDM methods), while others rely on desk analysis aimed at guiding and supporting the management of participation processes (i.e. stakeholder mapping, social network analysis, agent-based models).

It is worthy of notice that the framework proposed is comprehensive and should be adapted to the specific context under study. In this respect, stakeholder involvement is not an easy task and requires resources and *ad-hoc* skills to be developed. Therefore, it is important to plan the participation process well in advance by duly taking into account the resources available to carry it out.

Nevertheless, the proposed framework can be used by port authorities and local policy-makers as a guide to plan the sustainable development of ports and to understand how to deal with the complexity of multi-actor decisions in port planning.

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Assesing Home Port Potential of Selected Adriatic Ports

Marina Zanne, Bojan Beškovnik

The cruise industry has been continuously growing since the 1970s and is considered to be the fastest growing travel vacation segment ever. The Mediterranean is currently the second most visited region, closely following the Caribbean. One of the Mediterranean cruise markets is the increasingly interesting Adriatic Sea, with Venice and Dubrovnik as the most popular destinations. While a port of call destination need only offer attractions to be added to cruise line itineraries, much more is required of home ports, particularly in terms of infrastructure and passenger services.

Currently, the ports of Venice and Bari act as main home ports in the Adriatic, with the port of Trieste growing in importance although it does not as yet have a considerable share in terms of number of exchanged cruise passengers. In this paper, the authors take a look at the advantages that these ports offer in terms of home port adequacy and examine the home port potential of two Adriatic ports, namely the port of Koper and the port of Split. For this purpose, a list of influencing factors was drawn up based on existing studies and adjusted to the specific micro conditions and requirements. These factors are examined.

KEY WORDS
~ Cruise shipping
~ Home port
~ Adriatic region
~ Influencing factors
~ Survey

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1. INTRODUCTION

Sea cruising dates back to the nineteenth century when liner companies with spare passenger ships started to offer occasional cruising (Stopford, 2009) and almost everyone agrees that the first travel agent was Thomas Cook, who organized his first Grand Tour of Europe in 1856 (Dickinson and Vladimir, 2008). However, until the 1960s and the tourist boom of the Caribbean market in which cruises now account for more than 50 % of all tourist arrivals (Brida and Zapata, 2010) the cruising market was mostly limited to rich people. Thereafter, the cruise industry has become the fastest-growing and most rapidly emerging category in the leisure travel market (CLIA, 2017; Dickinson and Vladimir, 2008; Dowling, 2006); in fact it realized a 2,100 % growth since the 1970s (Repositioning Cruises, 2014). The industry continued to grow and a record was broken in 2016 with 24.2 million passengers cruising globally, i.e. 4 % more than in 2015, with estimated 25.3 million passengers anticipated in 2017 (FCCA, 2017). Although still a relatively small segment of the tourist industry, the cruise industry is certainly an important one; in 2015 the total economic impact of the global cruise industry was the generation of US$117 billion and opening of almost 957 thousand jobs, paying US$38 billion in wages and salaries (FCCA, 2017). However, cruise ships are simultaneously one of the most energy intense forms of tourist activity (Eijgelaar, Thaper and Peeters, 2010). This is due to the fact that cruise ships are essentially treated as big, luxury hotels throughout their journeys and emit huge amount of emissions while in port. In addition, cruise ships are tremendous generators of wastewater proven to have negative impact on the marine environment (Perić, 2016).

Nevertheless, the growth of the cruising industry may be attributed to the increasing number of users and the growing

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number of destinations. The cruising industry still has the potential for growth in both respects; people who take cruises are very loyal to cruising, with approx. 92 % stating they will probably or definitively book a cruise for a next vacation. In addition, younger generations are embracing cruise travel, rating it as a better vacation type than land-based vacations, all-inclusive resorts, tours, vacation house rentals, or camping (CLIA, 2017).

Driven by high occupancy rates and positive forecasts, cruise companies continue to expand their fleets; the current fleet of approximately 330 seagoing cruise vessels is to be expanded by sixteen new cruise ships, having the total capacity of more than 34,000 lower berths[1], in 2018 alone, with additional 77 ships with the capacity of approximately 223,500 lower berths already planned for delivery by 2027 (based on CIN (2018)).

Cruise shipping is a profitable sector significantly contributing to economies of the countries involved, although cruise passengers seem to daily spend less than 30 % of the expenditure of a land tourist (Brida and Zapata, 2010). Home port of course brings more money to the region, as the cruise tourists often spend some time before or after the cruise voyage in the city or its surroundings.

Currently, the global cruise port system is characterized by a high level of regional concentration and a clustering of port visits (Rodrigue and Notteboom, 2013) as illustrated in Figure 1, although apart from new destinations in established cruise regions, some new cruise markets are emerging, especially in Asia.

Figure 1.
The concentration of cruise markets (Source: Rodrigue & Notteboom, 2013).

The promotion of destinations and gaining of customers usually take place on fairs. In order for a shipping company to choose a port as a home port, the port must meet a number of criteria that are not dependent on the port itself or the attractiveness of the destination alone.

In this paper, the author analyses cruise traffic in the Adriatic, with particular attention given to the port of Koper and the port of Split. The main objective of the paper is to determine their growing potential and examine their home port potential.

2. THEORETICAL BACKGROUND

Cruise ports are generally divided into three categories, namely home ports, ports of call (also known as transit ports or destination ports) and hybrid ports. Home ports are ports where cruises begin and end, ports of call are intermediate stoppages and hybrid ports are the mixture of the previous two categories (Lakakou, Pallis and Vaggelas, 2009). In addition, some cruise companies allow boarding at a specific port as a part of a scheduled itinerary and disembarkation at the same port during the ship's next scheduled itinerary, in effect allowing passengers to do only a part of two regular cruises (Celebrity Cruises, 2018). This port is called an interport and the activity is known as interport sailing or interporting in which other than a regular

1. *Used to measure the normal capacity of a ship when two beds in each cabin are occupied.*

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home port for a line actually acts as a home port for a part of the passengers. Interporting thus simply means the creation of a secondary embarkation and disembarkation port on a cruise line. European cruise companies, such as MSC and Costa, have been doing this for years. This allows passengers to take the ship from their home city, or one that is closer to home, saving transportation and hotel costs (or the cost associated with flying to a particular city), and provides the line with new revenues. It also allows a passenger to pick a destination of more pre- and post-cruise interest (Reimer, 2012).

The direct economic benefits of cruise tourism for each destination arise from three principal sources (BREA, 2015):

- passenger onshore expenditures concentrated in shore excursions and retail purchases of clothing and jewelry;
- onshore spending by crew concentrated in purchases of food and beverages, local transportation and retail purchases of clothing and electronics; and
- expenditures by the cruise lines for supplies, such as food and beverages, port services, such as navigation and utility services, and port fees and taxes such as wharfage and dockage fees.

In average, passengers spend around EUR 95, and crew members EUR 25 per day in ports in EU countries with cruise tourism (EC, 2009). The latest available data for Europe show that each EUR 1 million in direct cruise industry expenditures generated EUR 2.42 million in business output and 19 jobs with an average annual wage of nearly EUR 33,700 (CLIA Europe, 2015).

According to Lakakou et al. (2009) a cruise port is generally interested in becoming a home port for one or more cruise companies. This is due to the high economic impact of this development on the port and the port related city. In fact, cruise passengers are estimated to spend six to seven times more money in home ports than at ports of call (CLIA Europe, 2007).

While minimum requirements for ports of call are clean and safe quay/pier/berthing, safe anchorage/tender spot (SeaConsult, 2012) and maybe simple check procedures, the list of requirements for cruise home ports is much more extensive. There are not many studies available on cruise home port selection criteria. Lakakou et al. (2009), Castillo-Manzano et al. (2014), Pallis (2015) and more recently Meng-Zhi et al. (2018) have been dealing with home port selection criteria and their prioritization. Castillo-Manzano et al. (2014) have created regression models on selected Spanish ports and found that ports located in populous areas with ample accommodation facilities, in the vicinity of large airports, not specialized in container traffic but sharing facilities with ferry traffic are more likely to attract cruise traffic. Lakakou et al. (2009) on the other hand drew up a list of 81 cruise home port selection criteria, and divided them into 12 categories and further into two groups, namely site characteristics and situation characteristics. They created a questionnaire and distributed it to 21 expert entities, including cruise companies, agents, cruise brokers, port authorities etc. to identify the most important factors. Among those 81 criteria, 31 have scored more than 4 points on the Likert scale, among which the availability of well-connected international airport with adequate capacity is the most important. Despite the case-by-case approach to home port selection, there are some major conditions that a cruise port itself must fulfil in order to become a home port. Pallis (2015) summarized them from Lakakou et al. (2009) as follows:

- the presence of adequate port infrastructure;
- the efficient provision of an extensive range of services to the cruise ship, the passengers and the crew; and
- connectivity with other transport modes.

Since international shipping always seeks a hospitable economic and political climate from which to operate, to keep costs competitive, cruise ships operators on occasion move from country to country, i.e. they switch from one home port to another (Klein, 2002). This means that ports face the constant risk of losing clients, not because of deficiencies in port infrastructure or terminal operations, but because the client has new and different requirements (Zarei, 2015).

3. DATA AND METHODS

Publically available quantitative data and data obtained through participation in the European strategic project EA SeaWay were used in the paper. The accuracy of publically available data is limited, e.g. the same publication may contain data for the same issue that are at odds with each other. In general, MedCruise data suggest a smaller number of passengers in the analysed regions since not all ports are included in the programme, but these data can still be used to get a general picture.

Five ports were included in the analysis - Venice, Bari and Trieste as existing home ports in the Adriatic, and Koper and Split as potential home ports. The analysed data cover a ten-year period from 2007 to 2016. The first cruise ship called to Split in 2002 and to Koper in 2005. The annual growth was expectedly enormous in these starting years (e.g. a 1,485% growth in Koper in 2007) and if included in the analysis they would yield rather misleading results.

Quantitative and qualitative analysis have been performed. Descriptive statistics were used to get a general picture of the performance of selected ports and several computations allowed the identification of trends. Based on the existing studies and using a multi-aspect approach a list of 14 criteria for home port selection was created. These criteria have been further examined for the selected five ports. For each of the analysed ports the main positive or negative issues have been identified and are presented further in the paper.

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4. THE ANALYSIS

The cruise product has become highly diversified and cruise companies develop new itineraries, new concepts and vessels for all kind of tastes (Papadopoulou and Sambracos, 2014) in order to attract more passengers and achieve even better financial results.

4.1. Cruise shipping in the Adriatic Sea

Around 6.59 million passengers were cruising European waters in 2015, accounting for 43.94 passenger and crew visit days at ports (BREA, 2016). In the same year, the cruise industry's total economic output in Europe reached EUR 40.95 billion, including EUR 16.89 billion in direct spending by cruise lines. It also accounted for more than 360,000 European jobs, generating more than EUR 11 billion in terms of employee compensation (CLIA Europe, 2015).

The Mediterranean area is the most attractive cruising zone in Europe (it is included in 75% of Europe's itineraries and is the fastest growing cruise destination in Europe (Papadopoulou & Sambracos, 2014)), and the world's second most popular cruising destination, closely following the Caribbean region. These two markets are complementary in the sense that the Caribbean region is dominantly serviced during the winter while the Mediterranean experiences a summer peak season (Rodrigue and Notteboom, 2012), so they are not in directly competing position, but are instead interconnected in an operational manner, particularly through the repositioning of vessel units to cope with variations in seasonal demand among the regional markets (Rodrigue and Notteboom, 2013). But with respect to passengers, in most cases they offer different attractions; while the growing popularity of exotic and resort destinations is noted in the Caribbean region, in the Mediterranean, the accent is on cultural attractions in close proximity to ports. The demand for different regions is thus mainly based on passenger preferences.

The Mediterranean region is divided into four sub regions; among which the Adriatic is the second most visited, only falling behind the Western Mediterranean.

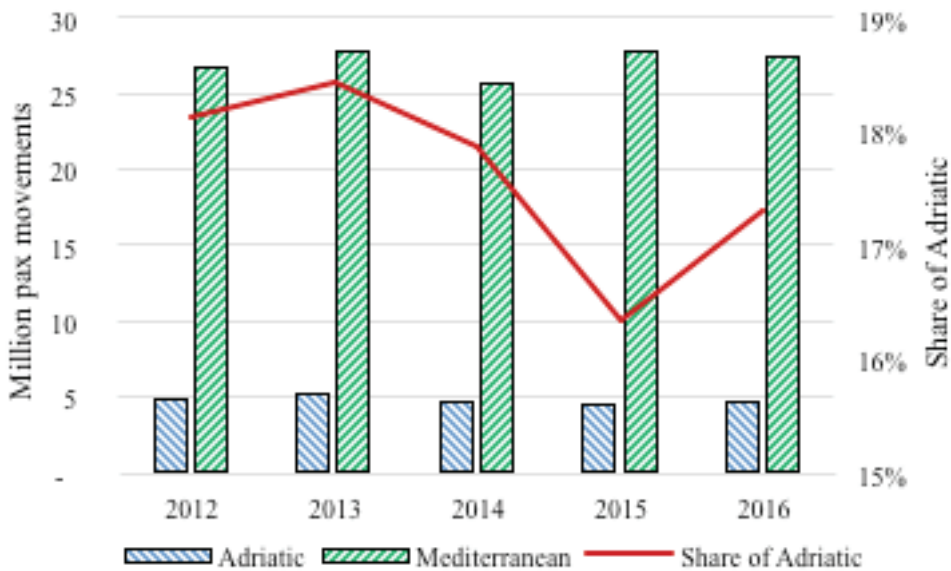

Figure 2.
Adriatic and Mediterranean pax movements. Source: (Risposte turismo, 2017).

When peace was restored in the Adriatic region in the mid 1990s, interesting new ports in Croatia were added to Mediterranean cruise itineraries which traditionally focused on Italy, Greece and Spain (Selinsky, 2010). The Adriatic region has a relatively steady number of passenger movements - around 5 million per season in the last decade.

Since the early 2000s, the number of ports of call has considerably increased in the Mediterranean Sea (Papadopoulou and Sambracos, 2014), and the Adriatic is not an exception. Currently around 30 cruise ports are in use by cruise lines in the Adriatic Sea. This is in line with the results of a survey which found that the diversification of ports of call and the attractions within

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the various ports were key factors for an itinerary to be successful and profitable (Tsamboulas, Moraiti and Koulopoulou, 2013).

As we can see in Figure 3, the port of Koper and the port of Split are both ranked among 10 top cruise ports in the Adriatic; however in 2016 their cumulative share in terms of passenger movements was barely 7 %. In fact, the majority of Adriatic cruise ports are small ports as the four most important ports cumulatively registered almost 75 % of all passengers' visits in 2016.

Cruise traffic in the Adriatic is present throughout the year, with the peak period from May to October accounting for more than 85 % (Risposte turismo, 2017), which is causing problems in many ports and port cities.

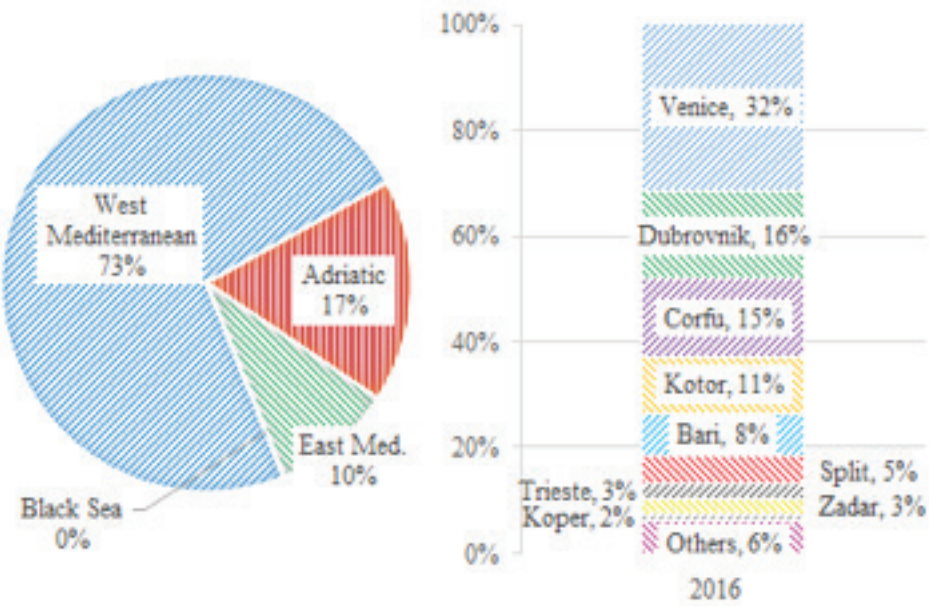

Figure 3.
Cruise passenger break down for the Adriatic. Source: based on (Risposte turismo, 2017).

4.2 Home port selection criteria

Based on the study by Lakakou et al. (2009) and the conclusions of Pallis (2015), using a multi-aspect approach for home port selection, we analysed the following criteria:

(1) the vicinity of an international airport;
(2) airport connections (regular lines);
(3) airport capacity / number of passengers;
(4) capacity for handling a large number of passengers simultaneously;
(5) infrastructure for passenger embarkation and disembarkation / baggage handling
(6) passenger services (duty free, food and beverage area, information desk);
(7) capacity (length of berths);
(8) passenger terminals / number of berths;
(9) tourist attractions (historic, cultural, entertainment);
(10) check-in desks / check-in desks for reduced mobility passengers / security screening lines;
(11) cost of services to cruise ships;
(12) services for ships;
(13) cost of services to passengers;
(14) (secured) parking.

Home ports in the Adriatic and home port potential of the ports of Koper and Split

The Adriatic is mainly characterized by transit cruise traffic although Venice, Bari and, more recently Trieste, account for a considerable share of embarkations and disembarkations in the total number of passenger movements.

Figure 5 illustrates the market position of the selected ports - three current rather important Adriatic home ports and two ports analysed to identify their home port potential. Expectedly, smaller ports have higher CAGR.

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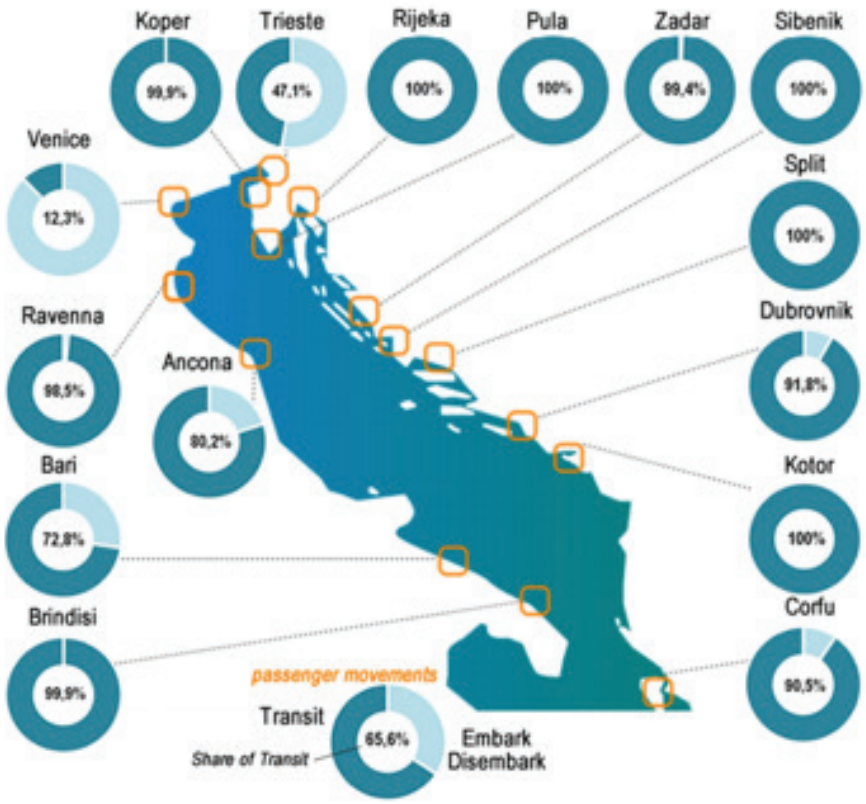

Figure 4.
Percentage distribution of cruise traffic between embarkations-disembarkations and transits, 2016. Source: (Risposte turismo, 2017).

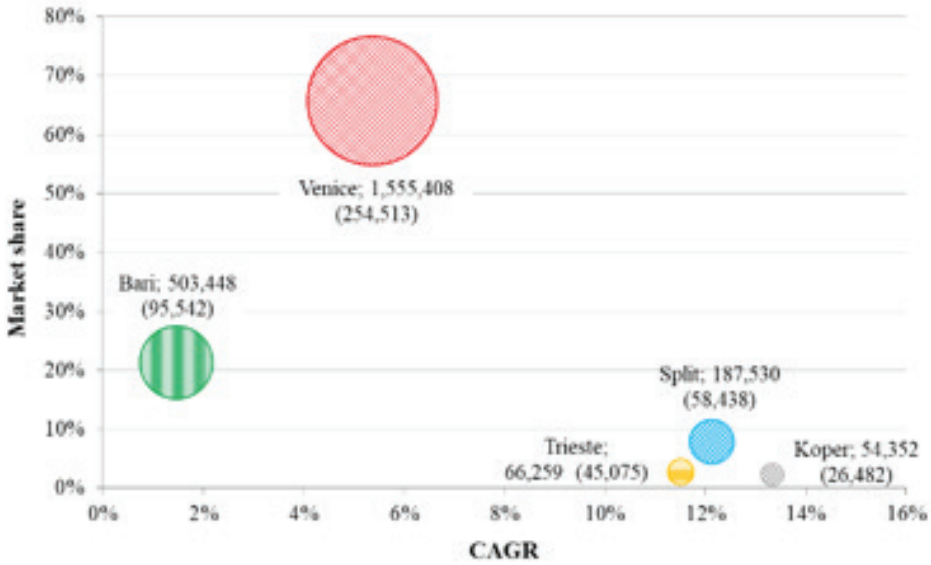

Figure 5.
CAGR, average market share, average number of passengers and standard deviation (in parenthesis) for the period 2007–2016. Source: based on internal EA SeaWay data (2014) and (Risposte Turismo, 2017).

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Please note that passengers are usually counted twice in home ports; during embarkation and during disembarkation and that small discrepancies between the two figures are commonplace due to the above mentioned diversification of cruising options.

4.3. Venice

Currently, Venice is by far the most visited Adriatic port with around 1.6 million passengers in 2016 (the number drops to approx. 900,000 if double counted passengers that embark and disembark in the port of Venice are not taken into consideration, which would change the picture somewhat). Anyways, it is the most important Adriatic home port and one of the most important Mediterranean home ports with around 700,000 embarkations.

There are two well connected international airports in the vicinity, offering more than 115 regular lines combined. In addition, the Venice's airport Marco Polo is the only airport in the Adriatic offering regular overseas connections.

However, Venice per se is a very visited city in general; the city now receives around 30 million tourists per year, and two or three cruise ships moored at any time can mean an extra 10,000 passengers disgorged into the narrow streets and squares of Venice (Mourby, 2017). So, Venice is facing a similar problem as the Croatian city of Dubrovnik - being overcrowded, especially in the summer months, but for Venice it's not only because of cruise passengers. In addition, the authorities have imposed a limit for the largest cruisers (over 96,000 GT), preventing access to the main cruise terminal through the Giudecca canal due to the damaging effect of the cruisers on the city's architectural supports; large ship motors are damaging the Venice's fragile, salt-corroded foundations. Although the decision was rejected in 2015, the problem persists and a ban on large cruise ships from the Giudecca canal remains a current topic, with almost 99 % of Venetians who voted at an unofficial referendum in June 2017 supporting the ban on these ships and their redirection to the industrial port of Marghera (Giuffrida, 2017).

4.4. Trieste

Although the port of Trieste serves as a home port for around half of the cruise tourists visiting the port, its approximately 60,000 cruise tourists are still negligible in comparison to Venice or Bari. This is possible due to adequate terminal capacities (9,900 square meters of outdoor and 7,200 square metres of indoor terminal capacities capable of accommodating two large cruise ships as a home port), well developed hinterland connections (although the connection from the cruise terminal to the highway system is 5 km away, but the railway station is at a walking distance from the terminal) and the proximity of the national airport.

The Trieste airport has sufficient spare capacity to accommodate additional passengers (although the airport capacity is around 1.5 million passengers (ACW, 2015) it approximately handled only 725,100 passengers (Trieste Airport, 2018) in 2016). In addition, a new intermodal hub will become operational on 19 March 2018, connecting the airport to the national rail network.

4.5. Bari

The proximity of an airport (less than 15 km away) gives Bari an opportunity to become a home port, and more than 27 % of cruise passengers that visited Bari actually boarded the ship in Bari itself. However, back in 2009, this share was around 40 %. Although Bari is a strategic port for Costa Cruises, it nevertheless lost one third of cruise passengers in the five-year period from 2012 to 2016.

4.6. Koper

The average expenditure per person by port is usually computed from questionnaires, although the quality of these data is frequently limited (Brida and Zapata, 2010). The expenditure assessment for Koper was made in the same way, through questionnaires. According to an estimation cruise ship arrivals with 65,434 passengers generated the revenue of around EUR 5 million for Slovenia in 2013 (Risposte Turismo, 2014). This is without taking into consideration the spending of crew and the broader multiplicative effects. Although number seems high, this is still negligible in comparison to EUR 2.09 billion (RTV SLO, 2014) that foreign tourists spent in Slovenia that same year. Nevertheless, the port of Koper sees the potential of the development of cruise tourism, the construction of a terminal building and consequently the provision of better passenger services.

The trend for cruise passengers visiting Koper is rather indecisive; the power function yields the best estimation and forecasts a slight increase in the coming years, but R2 is barely 0.6. Still, Koper is by far the most important passenger port in Slovenia.

When cruise ships started visiting Koper, Luka Koper, the managing and operating company in the port of Koper, began planning a EUR 10 million worth terminal building. In 2014, they made a less ambitious building plan worth EUR 1.5-2 million, to be constructed very quickly, in time to allow the port of Koper to become a home port in 2015. However, there are still no buildings at the passenger terminal. Once constructed, the structure will include the immigration police, customs, arrival and departure areas, luggage storage, duty free, info point and other shops and services, ensuring the passengers have a comfortable stay (MedCruise, n.d.). In the meantime the community spent

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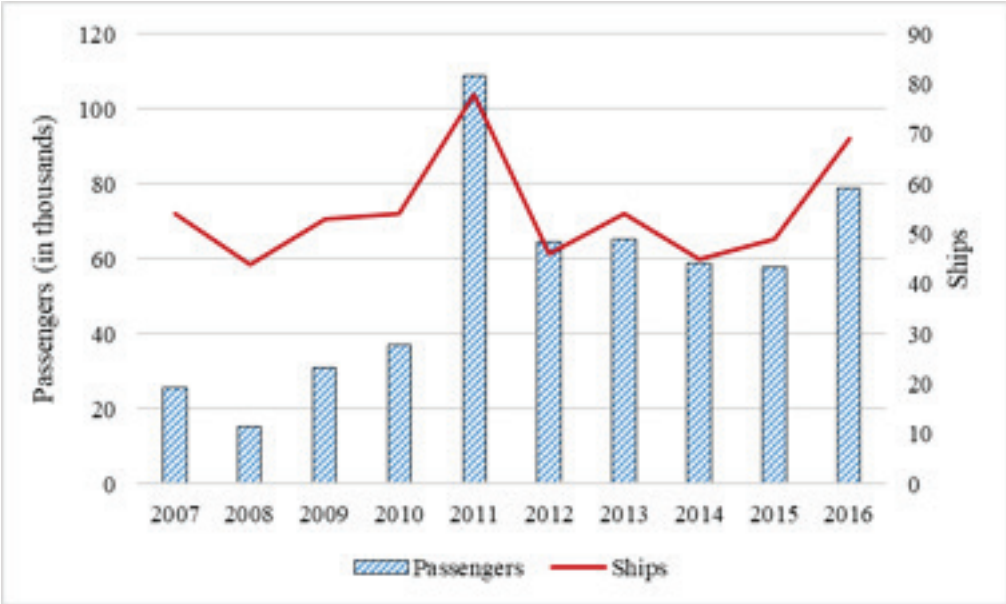

Figure 6.
Number of cruise passengers and cruise ship arrivals to the port of Koper in the period 2007-2016. Source: based on (Luka Koper, 2018).

around EUR 1.95 million on the expansion of the nearby park, beautification of about 700 meters of the promenade and the construction of the elevator bringing cruise passengers directly to the city centre; 85 % of these investments come from non-refundable European funds.

Although Slovenia has many attractions to offer, the national Ljubljana airport is located 125 km from Koper, which makes the Trieste airport the closest airport to the port of Koper (less than 70 km), but the two, the Trieste airport and the city of Koper, are not well connected.

4.7. Split

The port of Split is the largest Croatian passenger port, with around 5 million passengers per year; however, only around 280,000 are cruise passengers, which makes Split the second most important cruise port in Croatia, just behind the ancient city of Dubrovnik. In fact, Split is more often than not merely complementary to Dubrovnik (cruisers rarely call to Split alone).

Cruise traffic has considerably increased in the port of Split over the last decade – the traffic almost tripled between 2007 and 2016, to reach the already mentioned 280,000 passengers, while in the period 2014-2016 it increased by incredible 51 % – in spite of the lack of dedicated cruise vessel berths and lack of adequate facilities to greet and entertain passengers once they disembark.

The congestion issues in the port of Split in high season were problematic for the arriving cruise ships. Cruise ships were occasionally forced to leave Split due to their inability to berth or provide its passengers the adequate level of comfort and service. However, in 2017 the two outer berths were finished. With the length of 265 m and width of 30 m, they are capable of simultaneously accommodating two cruise ships of 320 m and 270 m respectively. The berths are equipped with border crossing points and sanitary facilities. An access road has been connected to the pier and other supporting infrastructure is present in order to offer high quality service to passengers.

Even without this important in-port acquisition, mathematical models considered the growth of cruise passengers with high coefficient of determination (R square above 0.81 in all options, besides logarithmic approximation).

The Split airport, only 24 km from the port, is currently undergoing a major expansion to accommodate increasing traffic, which has almost doubled in the past five years and is expected to reach even higher levels in the future. The ongoing development includes the renovation and expansion of the existing passenger terminal to enhance its capacity to 3.5 million passengers a year, and achieve new levels of safety and service quality (Airport Technology, 2017), i.e. the efficient handling of 2,500 passengers per hour (Bogdan, 2017). Fast rail connection between the Split airport and the port of Split is being considered.

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5. DISCUSSION

All current Adriatic home ports have enough terminal capacities with adequate berthing places, well dimensioned terminal buildings with all necessary accompanying services for passengers (check-in desks, waiting areas, luggage storages, souvenir shops, drink machines, transport choices (taxi, bus) etc.), rather good hinterland connections and dense airline connections, as well as a sufficient number of attractions either in the city or in its proximity.

All analysed ports are a part of the TEN-T network; Split is a part of the comprehensive network and all other ports of the core network. This means that they will all benefit from EU financial aids which will be directed into the development of the ports' infrastructure, and the infrastructure connecting the ports with their hinterlands. This could increase their home port potential.

However, although the Adriatic offers many attractions, and regardless of the statement of Rodrigue and Notteboom (2013) that cruise industry sells itineraries and not destinations, it seems that cruise shipping in the Adriatic is still heavily dependent on Venice and Dubrovnik. Both ports struggle with city congestion, and Venice additionally has cruise terminal access issues. If these problems persist, the picture of cruising in the Adriatic could dramatically change; cruising could disappear from the North Adriatic, or other new home ports could emerge in the region. In this event, Trieste is much better positioned than Koper; it is closer to Venice, it has better airline and land connections, as well as passenger terminal facilities. Furthermore, cruise companies tend to be involved in the development, management and operations of the home ports they use (Pallis, Rodrigue and Notteboom, 2014); there is no port authority in Koper, and after the initial enthusiasm over cruise shipping, it is now clear that much higher revenues are generated with cargo handling activities.

Cruise activities are typically seen as income generators for the economy in which they take place. The growth of the industry has socioeconomic benefits for all stakeholders (Pallis, Rodrigue and Notteboom, 2014). These benefits are not unconditional and do not come without certain negative effects, like pollution and congestion. So port authorities, municipalities (local communities) and regions or national governments must be united in decisions on this type of tourism.

According to crew.center (2017) some ships already call to the port of Split several times per season, but only MSC Sinfonia calls on a weekly basis, 20 times per year. This would allow interporting in Split, provided all stakeholders consider this activity profitable and the required investments, mainly into the terminal building with all necessary passenger facilities and adequate parking capacities, are insured. This would be a reasonable upgrade of a EUR 23.3 million investment into much needed outer berths. Interporting would allow passengers to spend time in the city or on the islands before or after their voyages, thus generating additional economic impacts through their tourism expenditures.

Public and private investments have been channelled into many ports where cruise ship callings have increased, to revitalize older port areas encompassing housing, hotels, maritime heritage projects, sports, recreation, tourism and local commerce (Rodrigue and Notteboom, 2013). Non-refundable EU funds are likewise available for cruise port projects.

Since with 6.67 million Europeans cruising in 2016, Europe is the second largest source market worldwide, after the USA, accounting for about 30 % of all cruise passengers worldwide, the exclusively intra-continental links don't necessarily have to be an obstacle (plus non-direct overseas lines available). The majority of European cruise passengers, over 75 %, come from 5 countries, namely Germany, the UK & Ireland (together), Italy, France and Spain. And 3.4 million of European cruise passengers chose the Mediterranean for their destination (CLIA, 2017). While Split airport has direct diversified regular links to these countries, there are no direct flights from Ljubljana to Spain, Ireland or neighbouring Italy. This is another advantage if Split decides to consider the interporting option.

6. CONCLUSIONS

The analysis confirmed that at the moment neither of the two ports of interest, namely Koper and Split, has the possibility to become a home port. They can compete with Italian ports in terms of prices (e.g. while in Venice ship call price is from EUR 1,500 on, it is charged EUR 450 in Koper and depending on gross tonnage in Split; similarly in Koper each passenger is charged EUR 4, transit or home port passengers alike, while in Venice this charge is EUR 7.59 per transit passenger and EUR 16.24 to EUR 25.71 per home port passenger (VTP, 2017), (LK, 2017), (SPA, 2016)). However, they lack some other decisive elements, mainly terminal buildings with appropriate passenger services and larger parking areas. Nevertheless, Split is registering a very rapid growth in the number of passengers; in 2016 almost 280 thousand cruise passengers visited Split (187 thousand in average in the analysed period and the trends suggest further growth). In addition, new capacities for receiving cruise ships have been constructed in the meantime, and the current schedule of cruise ship arrivals suggests that the port of Split could become an interport in the near future, but this still requires a number of important in-port investments, mainly the construction of a modern terminal building and the expansion of parking capacities. The construction of a new terminal building has been included in short-term plans and better land access to the port is under consideration.

Koper, on the other hand, recorded a higher compound annual growth than Split in the period under review, but this is

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mainly due to the later entry into the cruise market and very high growth in the early years. Compared to Trieste, Koper is less likely to become a home port if large cruise ships are banned from Venice. Nevertheless, terminal building with adequate services for passengers should be constructed in Koper to give a more pleasant first impression and facilitate the experience of the check procedure for passengers, simultaneously increasing the possibly that more revenue will be yielded from services offered to passengers directly at the terminal. In fact, as Marksel et al. said (2016), a supportive policy framework and products and services of appropriate quality are essential for the stimulation of higher consumption and passenger satisfaction.

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The Manchester Coded Data Based OFDM (MCOFDM)

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This paper shows a new DWT based OFDM algorithm which significantly simplifies signal processing in the transmitter and receiver. Unlike conventional DWT based OFDM a new algorithm does not use digital modulation of subcarriers either IDWT in the transmitter. The output signal from the transmitter is formed by summing the signals on the individual subchannels, encoded with the Manchester code and sampled at appropriate frequencies. In the receiver, the channel signal and data is reconstructed using DWT and Haar wavelet. Although the signal transmission is achieved using amplitude modulation, the paper shows that BER performance is commensurable to BPSK or DMWT based OFDM in the presence of AWGN.

KEY WORDS
~ Manchester code
~ Haar wavelet
~ OFDM

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1. INTRODUCTION

Although the advantages of DWT based OFDM in comparison to FFT based OFDM are well known and the performance of such systems measured in the channels with different types of noise and digital modulation of the subcarriers as well, detailed insight into the applied transformations is usually missed. Hence, possible optimization of such systems resulting with improved performance and/or efficiency of the hardware components is omitted too. In this paper, the attention is oriented to the well-known data coding procedure (a Manchester code) which revealed very interesting properties if the Haar wavelet transformation is performed under specific conditions. This way, a completely new, digitally coded (OFDM) subcarrier transmission appears across AM modulation scheme, with improved performance regarding the complexity of used hardware and BER performance commensurable to BPSK or DMWT based OFDM in the presence of AWGN.

To present the idea clearly, the paper is organized as follows. In Section II which follows, the main characteristics of the OFDM system are described. Section III describes the effects of specific DWT compression applied to the digital signal represented using Manchester code. In Sections IV and V, the proposed procedure is used for the new, compressed based OFDM method and the effect on the hardware requirements reduction is presented. The standard analysis of such systems in terms of BER performance is presented in Section VI, and the possible further improvements of such systems regarding the signal type transmission across the subcarriers. Section VII concludes the paper.

2. ORTHOGONAL FREQUENCY MULTICARRIER MODULATION TECHNIQUES

Orthogonal frequency division multiplexing (OFDM) is a multicarrier modulation technique which divides the

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available spectrum into a number of parallel subcarriers where each subcarrier is modulated by a low rate data stream at the different carrier frequency. Each subcarrier is modulated with a conventional modulation scheme such as QAM (quadrature amplitude modulation) or PSK (phase shift keying) at a low symbol rate, maintaining total data rates similar to conventional single carrier modulation schemes in the same bandwidth. Multicarrier modulation schemes divide the input data into bands upon which modulation is performed and multiplexed into the channel at different carrier frequencies so that information is transmitted on each of the subcarriers. Individual subcarriers are orthogonal to each other, which allows overlapping of subcarriers because the orthogonality ensures the separation of subcarriers in the receiver. This approach suppresses channel distortion and improves the spectral efficiency considering to other types of systems like Frequency Division Multiple Access, where no spectral overlap of carriers is allowed (Dawalbait and Bilal, 2016).

The OFDM is used in many applications such as IEEE 802.11 wireless standard, Cellular radios, GSTN (General Switched Telephone Network), DAB (Digital Audio Broadcasting), DVB-T (Terrestrial Digital Video Broadcasting), HDTV broadcasting, DSL and ADSL modems and HIPERLAN type II (High Performance Local Area Network) (Hara and Prasad, 2003; Li and Stüber, 2006).

The OFDM systems are very sensitive to phase noise and CFO (carrier frequency offset - the frequency drifts in oscillators, radio propagation, and Doppler shift). These phase distortions destroy the subcarriers' orthogonality and lead to common phase error and ICI (inter carrier interferences). Many approaches have been proposed to estimate and eliminate phase noise effects in OFDM systems over frequency selective channels. These techniques can be divided into the frequency domain and time domain approaches (Septier and Delignon, 2011).

The FFT based OFDM uses IFFT in the transmitter for simultaneous parallel multiplexing and to generate orthogonal subcarriers and FFT in the receiver for separation of orthogonal subcarriers. The main disadvantage of FFT based OFDM is using a rectangular window which creates high side lobes. Moreover, the pulse shaping function used to modulate each subcarrier extends to infinity in the frequency domain. This leads to high interference and lower performance levels (Lakshmanan and Nikookar, 2006). Inter symbol interference (ISI) and inter carrier interference can be avoided by adding a cyclic prefix (CP) to the beginning of the OFDM symbol. A CP is added to every symbol to combat the delay spread introduced by multipath channel and the length of CP must be at least the same size as the expected channel delay spread. It can reduce the spectrum efficiency for 20-25 % (Lakshmanan and Nikookar, 2006) or more.

The DWT based OFDM system uses IDWT in the transmitter for simultaneous parallel multiplexing and to generate orthogonal subcarriers and DWT in the receiver for separation of orthogonal subcarriers. Both systems FFT and DWT based OFDM share many similarities in terms of their functions (orthogonal subcarriers and overlapping of which makes them spectrally efficient). But, they have also some distinctive features that make them different from each other. Wavelet transform provides the time-frequency representation of signals, whereas discrete Fourier transform gives only the frequency representation. Therefore, in FFT based OFDM system subcarriers overlap in the frequency domain, whereas in DWT based OFDM system subcarriers overlap in both time and frequency domain. DWT based OFDM symbols fulfill the property of double shift orthogonally and therefore, their overlapping does not cause ISI and does not require CP. This feature makes DWT based OFDM system more spectral efficient compared to FFT based OFDM system (Oksuz et al., 2016; Parihar and Singh, 2017). Furthermore, their basic functions are different. Fourier transform decomposes a signal into sinusoidal basis functions of different frequencies whereas wavelet transform decomposes a signal into a set of mutually orthogonal wavelet basis functions. Unlike Fourier transform, wavelet transform has the ability to analyze the local properties of the input signal such as edges or transients. Wavelet based OFDM is simple to implement with less complexity than FFT based OFDM.

Many authors use computer simulations to analyze and compare FFT and DWT based OFDM system using different modulation techniques such as M-PSK and M-QAM considering to three distortion channels: AWGN-additive white Gaussian noise (Dawalbait and Bilal, 2016; Shadab and Madhav, 2015; Oksuz et al., 2016; Parihar and Singh, 2017; Chauhan and Tyagi, 2014; Goyani and Shah, 2015; Ghaith et al., 2013; Gupta and Tiwari. 2013; Kattoush, Mahmoudb and Nihadc, 2010.), Rayleigh (Dawalbait and Bilal, 2016; Shadab and Madhav, 2015; Oksuz et al., 2016; Goyani and Shah, 2015; Kumbasar and Kucur, 2012; Gupta and Tiwari, 2013) and Rician fading channel (Dawalbait and Bilal, 2016; Shadab and Madhav, 2015; Kattoush, Mahmoudb and Nihadc, 2010). The BER (bit error rate) as a function of the energy per bit to noise ratio Eb/N0 and signal to noise ratio SNR have been used for performance comparison. The results of these computer simulations clearly show that DWT based OFDM outperformed the FFT based OFDM system in all three distortion channels in terms of BER. Adaptive modulation technique can additionally improve BER performance (Ali, 2015). In the comparison of BER performance of FFT and DWT based OFDM system, wavelet based OFDM system gives 1 dB improvement in AWGN channel and 2–8 dB improvement in Rayleigh fading channel (Gupta and Tiwari. 2013).

Considering to the CFO, DWT based OFDM also outperforms FFT based OFDM using DPSK (Sonu and Priya, 2016) and M-PSK (Jhingan and Kansal, 2016) modulations in the presence of AWGN. Also in Lee and Ryu (2018) it is shown that all systems of wavelet-OFDM considering various wavelets confirm PAPR (peak to average power ratio) performance lower than conventional OFDM.

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The DMWT (Discrete Multiwavelet Transform) based OFDM achieves much lower bit error rates and better performance than FFT-OFDM and DWT-OFDM in the presence of AWGN. To have a BER = 10−3 DMWT based OFDM requires 10 dB SNR, while DWT-OFDM requires 16.5 dB and FFT-OFDM requires 31.5 dB SNR (Kattoush, Mahmoudb and Nihadc, 2010).

Comparing the commonly used wavelets (Haar, Daubechies, Biorthogonal...) in DWT based OFDM, computer simulations show that Haar and Biorthogonal wavelet have better performance in terms of BER (Veena et al., 2014; Bodhe, Joshi and Narkhede, 2012; Gupta and Tiwari, 2013).

In typical DWT based OFDM transmitter, a high data rate stream passes through encoder which is consisted of convolutional encoder followed by interleaver. This encoding technique is used for error correcting and it is used not only in OFDM systems. After encoding, the data stream is brought to the serial to parallel converter which converts the high rate serial data into lower rate parallel data, and then the data is brought to the modulator. In modulator, the subcarriers are modulated by the parallel data streams using PSK or QAM digital modulation technique, and then the signals proceed to IDWT. After IDWT the carrier mapping is used to raise subcarriers frequency to the main carrier frequency.

This paper introduces a new DWT based OFDM algorithm which significantly simplifies signal processing in the transmitter and receiver. Unlike conventional DWT based OFDM, a new algorithm does not use digital modulation of subcarriers either IDWT in the transmitter. IDWT is not used at all, but DWT is used in the receiver for signal and data reconstruction. It is achieved using appropriate data sampling and coding. A Manchester coded data stream in subchannels and their sum is a method to compose OFDM signal in the transmitter and Haar wavelet is used for signal and data reconstruction in receiver's DWT.

3. ORTHOGONAL CODING USING MANCHESTER CODE AND HAAR WAVELET

One of the most important assumptions in OFDM systems is a strict relation among carrier frequencies i.e.

$$f_n = f_c + \Delta f * n$$

where f_c is a carrier frequency, Δf is a symbol frequency and n is an integer. Therefore, the carriers are orthogonal to each other and packed tight enabling the overlapping of the subcarrier and increasing the spectral efficiency of the transmitted signal. However, considering that DWT OFDM outperforms FFT based OFDM due to double shift orthogonality, we were curious if the multiplexing (OFDM) procedure as a whole can be improved. Having a deeper insight into the specific DWT transformation over the Manchester coded data, an interesting property appeared which prompted the idea of generating the subcarriers data using DWT. The step by step procedure is minutely described in the text which follows, and the properties of the specific coded data and how it can be used for subcarrier definition are explained.

Generally, the DWT decomposition scheme is shown in Figure 1. Input signal (data) *x(n)* is passed through half band low (L) and half band high (H) pass filters resulting with the filtered sequence of data *g(n)* and *f(n)* respectively. If the Haar wavelet is used then the filter's coefficients are $l(n)=[1/\sqrt{2},1/\sqrt{2}]$ for L filter and $h(n)=[-1/\sqrt{2},1/\sqrt{2}]$ for H filter. After the downsampling procedure, the output sequences *g(2n)* or *cD* (detail coefficients) and *f(2n)* or *cA* (approximation coefficients) are obtained.

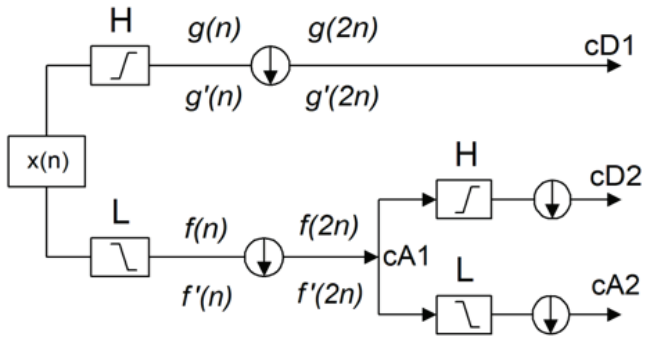

Figure 1.
A two-level discrete wavelet decomposition scheme.

Lemma1: If the discrete Haar wavelet function (Figure 2a)

$$\psi(n)=\begin{cases} 1 & n=0 \\ -1 & n=1 \\ 0 & otherwise \end{cases} \quad (1)$$

is applied for decomposition of the input function

$$x(n)=\begin{cases} 1 & 0 \le n < N \\ -1 & N \le n < 2N \\ 0 & otherwise \end{cases} \quad (2)$$

where *x(n)* represents the dilated Haar wavelet function for dilatation factor *N*, where $N \varepsilon N$ (Figure 2c), then detail coefficients are:

$$cD_1 = 0 \quad (3)$$

if the dilatation factor *N* is even. The same is worth for *x(-n)* function.

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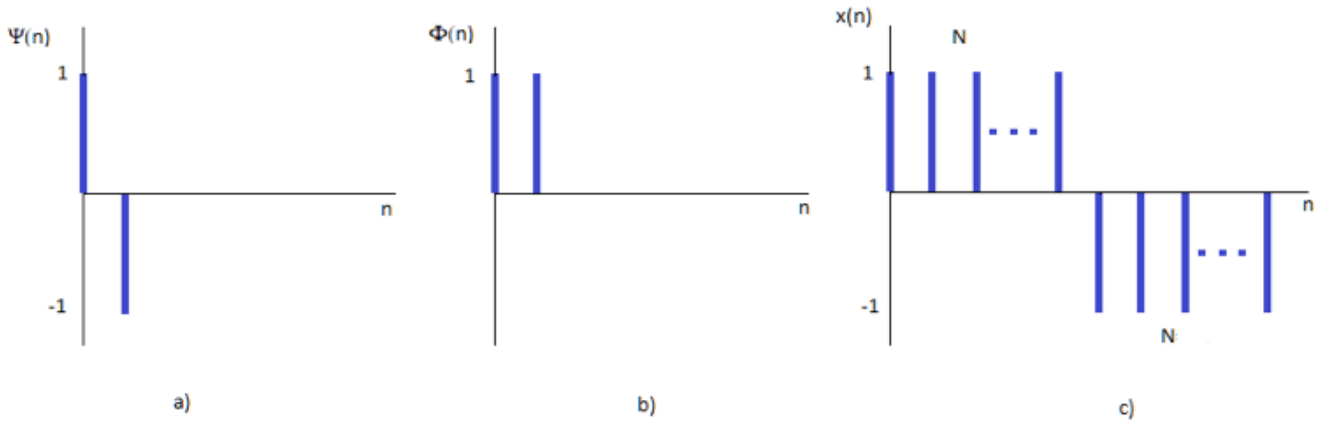

Figure 2.
Haar wavelet (a), Haar scaling function (b) and x(n) - dilated Haar wavelet for factor N (c).

Discussion: Considering the DWT decomposition scheme, convolutions $g(n)=x(n)*\psi(n)$ and $g'(n)=x(-n)*\psi(n)$ for different N are shown in Table 1. After downsampling, the detail coefficients $cD_1=g(2n)$ or $cD_1'=g'(2n)$ appear. In Table 1, $g(2n)$ and $g'(2n)$ are marked with orange color. It can be observed that $g(2n)$ and $g'(2n)$ have all zeros if N is even.

Table 1.
Convolution results of discrete functions x(n) and ψ (n) for different N.

N	g(n)=x(n)*ψ(n)	g'(n)=x(-n)*ψ(n)
1	1, -2, 1	1, 2, 1
2	1, 0, -2, 0, 1	-1, 0, 2, 0, -1
3	1, 0, 0, -2, 0, 0, 1	-1, 0, 0, 2, 0, 0, -1
4	1, 0, 0, 0, -2, 0, 0, 0, 1	-1, 0, 0, 0, 2, 0, 0, 0, -1
5	1, 0, 0, 0, 0, -2, 0, 0, 0, 0, 1	-1, 0, 0, 0, 0, 2, 0, 0, 0, 0, -1
6	1, 0, 0, 0, 0, 0, -2, 0, 0, 0, 0, 0, 1	-1, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, -1

Lemma 2: If the discrete Haar scaling function (Figure 2b)

$$\Phi(n)=\begin{cases}1 & n=0\\ 1 & n=1\\ 0 & otherwise\end{cases} \quad (4)$$

is applied for decomposition of the function $x(n)$ represented by the dilated Haar wavelet function (Figure 2c), then approximation coefficients are:

$$q\cdot cA_1 = x(2n) \quad (5)$$

if the dilatation factor N is even. The same is worth for $x(-n)$ function.

Discussion: Considering the DWT decomposition scheme, convolutions $f(n)=x(n)*\Phi(n)$ and $f'(n)=x(-n)*\Phi(n)$ for different N are shown in Table 2. After downsampling the approximation coefficients $cA_1=f(2n)$ or $cA_1'=f'(2n)$ appear. In Table 2, $f(2n)$ and $f'(2n)$ are marked with orange color. It can be noted that $1/2\ f(2n)=x(2n)$ if N is even.

Using the results from Table 1. and Table 2. it is obvious that detail coefficients cD_m will all be zero if $N=2^m$. In general, for m decomposition level and $N=2m$ the approximation and detail coefficients are:

$$q\cdot cA_m = x(2^m\cdot n) \quad and \quad cD_{1,2,3\ldots m}=0 \quad (6)$$

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Table 2.
Convolution results of discrete functions x(n) and Φ(n) for different N.

N	f(n)=x(n)*Φ(n)	f'(n)=x(-n)*Φ(n)
1	1, 0, -1	-1, 0, 1
2	1, 2, 0, -2, -1	-1, -2, 0, 2, 1
3	1, 2, 2, 0, -2, -2, -1	-1, -2, -2, 0, 2, 2, 1
4	1, 2, 2, 2, 0, -2, -2, -2, -1	-1, -2, -2, -2, 0, 2, 2, 2, 1
5	1, 2, 2, 2, 2, 0, -2, -2, -2, -2, -1	-1, -2, -2, -2, -2, 0, 2, 2, 2, 2, 1
6	1, 2, 2, 2, 2, 2, 0, -2, -2, -2, -2, -2, -1	-1, -2, -2, -2, -2, -2, 0, 2, 2, 2, 2, 2, 1

where q is a normalized factor.

Lemma 3: If the Haar DWT decomposition is applied to the function

$$s(n) = \sum_i \xi_i \cdot x(n - i \cdot 2^{m+1}) \quad (7)$$

composed of shifted *x(n)* and/or *-x(n)* i.e. $\xi_i \in \{1,-1\}$ (Manchester coded random binary data sequence) (Figure 3), where m is decomposition level, then detail coefficients will all be zero and approximation coefficients exist at *m* decomposition level.

Discussion: As the signal definition (the number of samples could be expressed as an exponent of base 2) meets the Lemma 1 requirement, the detail coefficients of the next decomposition level are zero. From Lemma 2, approximation coefficients of the next decomposition level are scaled values of the previous level (upsampled) approximation coefficients. Therefore, their values are the same and the number of samples could be expressed as an exponent of base 2 so again, according to Lemma 1, their detailed coefficients on the next decomposition level are zero. Consequently, the signal decomposition results with approximation coefficients which exist at only one (*m*) decomposition level.

The process is illustrated in Figure 3. An example of *s(n)*, defined for *m=2, N=2^m=4* and composed of *x(n), x(n-8), -x(n-16), x(n-24)* is shown in Figure 3a, whereas its two-level DWT decomposition is shown in Figure 3b. It can be noted that cA_2 represents the narrowest version of *s(n)* and in general, cA_m will represent the narrowest version of *s(n) if* $N=2^m$.

However, if the decomposition level increases by $k \in N$ with the same *N*, where $N=2^{m-k}$ (in Figure 1 input sequence for 3rd decomposition level is cA_2) the result for cD^{m+1} and cA^{m+1} would correspond to the every even and negative values shown in Tables 1. and 2. for *N=1*. Of course, it is necessary to multiply by the normalizing factor in order to obtain the exact results in regard to the data in the tables. The results are shown in Figure 4a for *k=1, m=2, N=4* and Figure 4b for *k=2, m=2, N=4*.

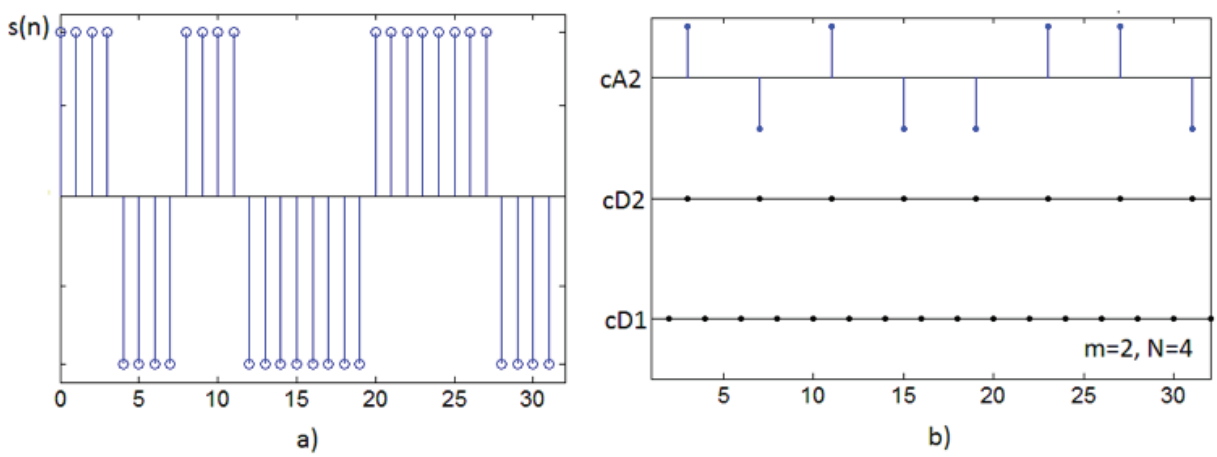

Figure 3.
Input sequence s(n) (a), two-level DWT decomposition of s(n) (b).

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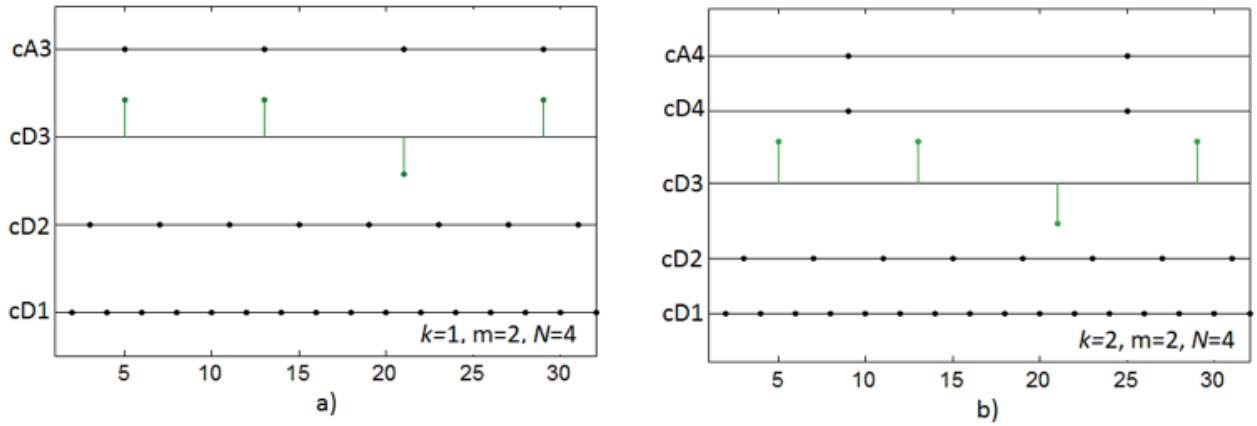

Figure 4.
Three-level decomposition of s(n) (a), four-level decomposition of s(n) (b).

It can be noted that sign of the detail coefficients at the *m+1* level (in above examples cD_3) represents coefficients $\xi_i \in \{1,-1\}$ of the function s(n). Furthermore, all the energy is concentrated in just one filter bank i.e. in just one subchannel. All these observations expressed through Lemma 1 and Lemma 2 found the base for orthogonal coding using the Manchester code and DWT decomposition with Haar wavelet explained in the next section.

4. MCOFDM SIGNAL COMPOSITION

Let us suppose that input binary data u_1=(1, 1, 0, 1), u_2=(0, 1, 1, 0, 1, 0, 1, 1) and u_3=(0, 1, 1, 1, 1, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 1) in three subchannels are set (the number of data in subchannels must increase with power of two). All the data in subchannels u_n are coded by the Manchester coding scheme but with different clock frequency $f_n = f_1 \cdot 2^{n-1}$ where n is a subchannel number. After Manchester coding, all encoded signals in subchannels *sn(t)* (every *sn(t)* correspond to un) are summed and the result is *s(t)*. The general algorithm of MCOFDM signal composition on the transmitter side is shown in Figure 5 and in general *s(t)* is defined as:

$$s(t) = \sum_{n=1} \sum_{i=0} \psi\left(\frac{t-i}{2^{1-n}}\right) \cdot [2 \cdot u_{n,i} - 1] \quad (8)$$

where *n* is subchannel number, *i* is data ordinal number in subchannel u_n and $\psi(t)$ is continuous Haar wavelet defined as:

$$\psi(t) = \begin{cases} 1 & 0 \le t < ½ \\ -1 & ½ \le t < 1 \\ 0 & otherwise \end{cases} \quad (9)$$

According to the above defined data u_1, u_2 and u_3, appropriate signals in subchannels $s_1(t)$, $s_2(t)$, $s_3(t)$ and theirs sum *s(t)* are shown in Figure 6.

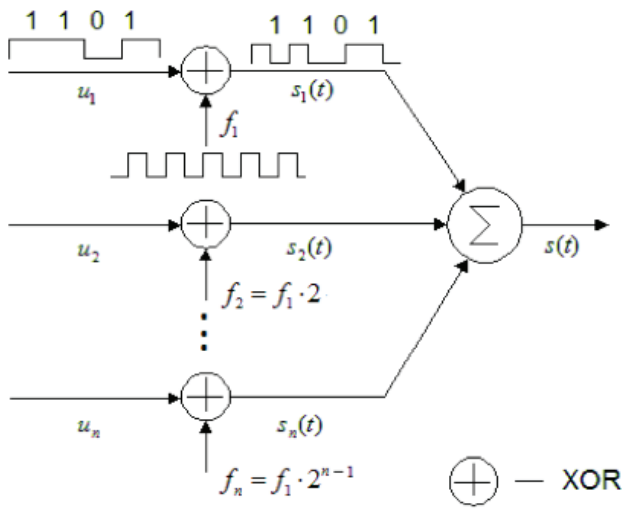

Figure 5.
MCOFDM signal composition.

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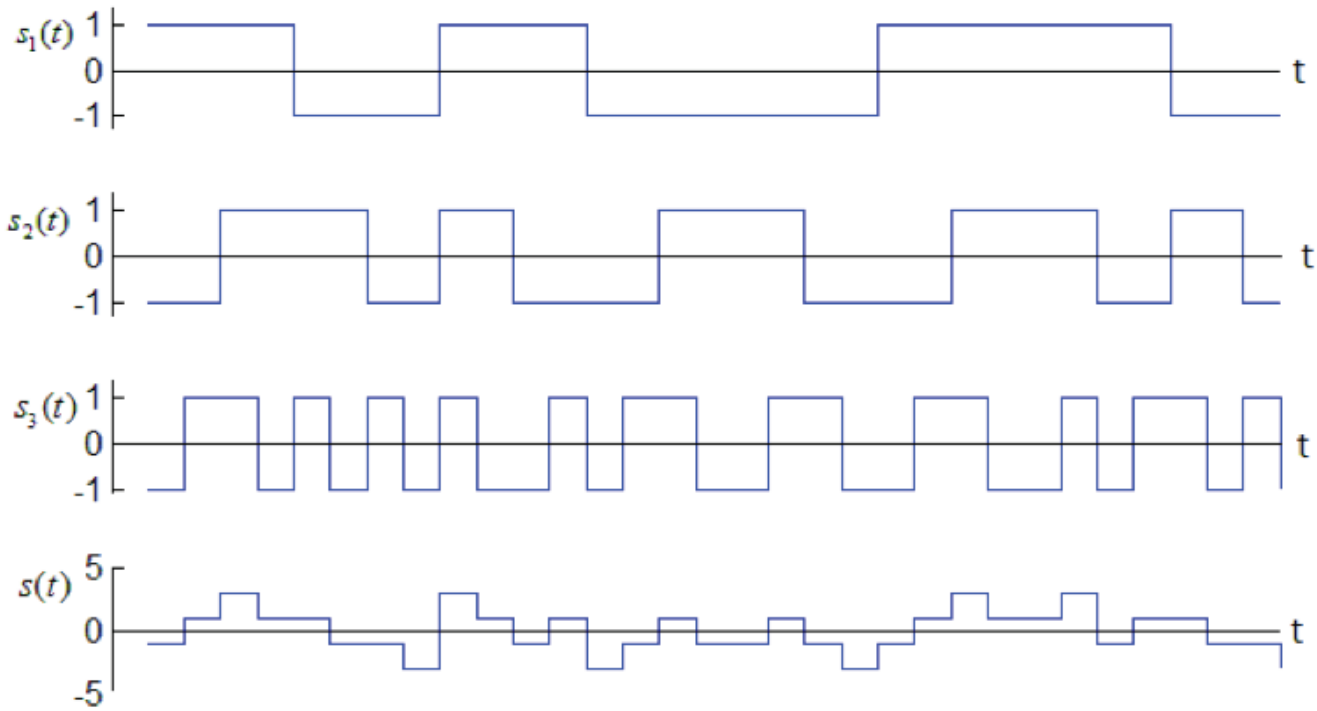

Figure 6.
Subchannel signals $s_1(t)$, $s_2(t)$, $s_3(t)$ and theirs sum s(t).

5. MCOFDM SIGNAL DECOMPOSITION – BINARY DATA RECONSTRUCTION

As a standard OFDM procedure on the receiver side, the DWT decomposition scheme (see Figure 1 for two-level decomposition and some input signal *x(t)* has to be performed. If the sampling frequency is $F_s = f_n = f_1 \cdot 2^n$ (in this example $F_s = f_1 \cdot 8, n = 3$) and the input signal is $s(t)=s_1(t)+s_2(t)+s_3(t)$, the output decomposition coefficients for 3-level DWT decomposition are shown in Figure 7a.

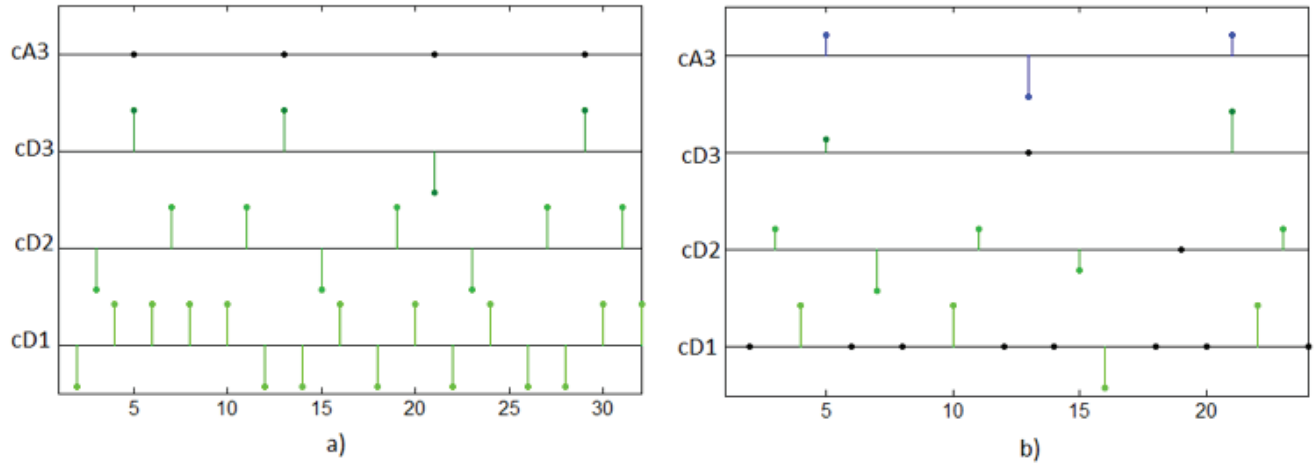

Figure 7.
Decomposition coefficients of s(t) for sampling frequency $F_s = 8\ f_1$ (a), decomposition coefficients of $u_1(t)$ for sampling frequency $F_s = 6\ f_1$ (b).

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As shown in Figure 7a the output decomposition coefficients *cD3, cD2 and cD1* correspond to input data u_1, u_2 and u_3 respectively (the positive values correspond to the logical ones and the negative to the logical zeros). If data in subchannels are not coded by Manchester code or $F_s \neq f_1 \cdot 2^n$ or $f_n \neq f_1 \cdot 2^n$ the energy will not concentrate in only one subchannel and the reconstruction will not be possible in the described way. The mentioned case is illustrated in Figure 7b where the binary input data is $u_1 = (1, 1, 0, 1)$ which correspond to $s(t) = s_1(t)$ and $F_s = 6 \cdot f_1$. According to above data reconstruction algorithm, it is not possible to obtain input data u_1 directly from decomposition coefficients (note that zeros in *cD1* are not defined) and the energy is dispersed through the subchannels causing the interference in the adjacent subchannels. Moreover, even in the case of jitter ($u_1 = (1, 1, 0, 1)$), but rectangular pulses after Manchester coding on the receiver side do not have the same width, see Figure 8a) reconstruction is possible in that subchannel (see *cD3* in Figure 8b), but the energy is also dispersed through the subchannels causing the interference in the adjacent subchannels.

6. BER PERFORMANCE

The BER performances for MCOFDM over AWGN channel were gained using Matlab programming according to the scheme on Figure 9.

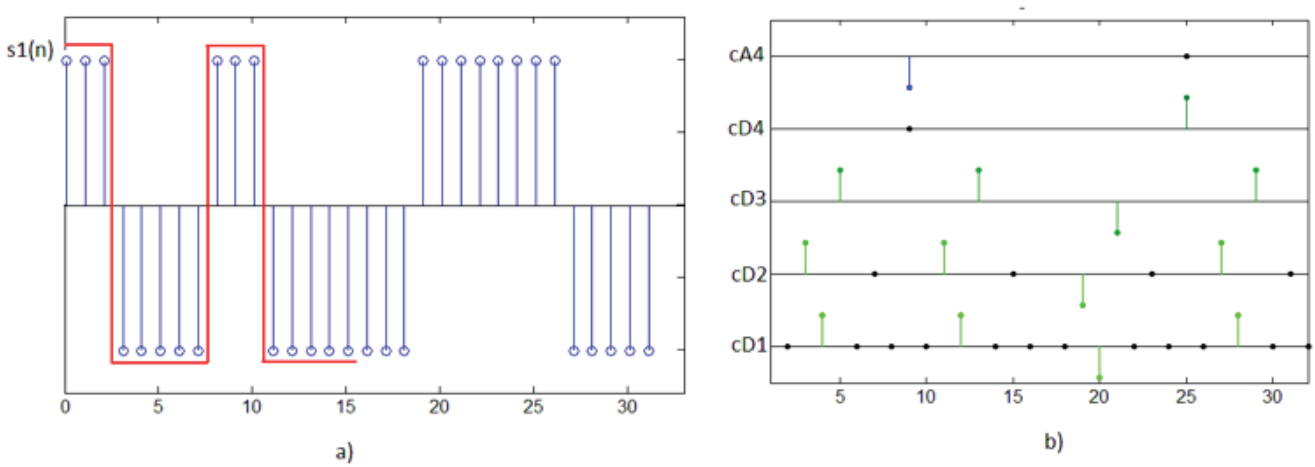

Figure 8.
Jitter - rectangular pulses do not have the same width (a), decomposition coefficients in case of jitter (b).

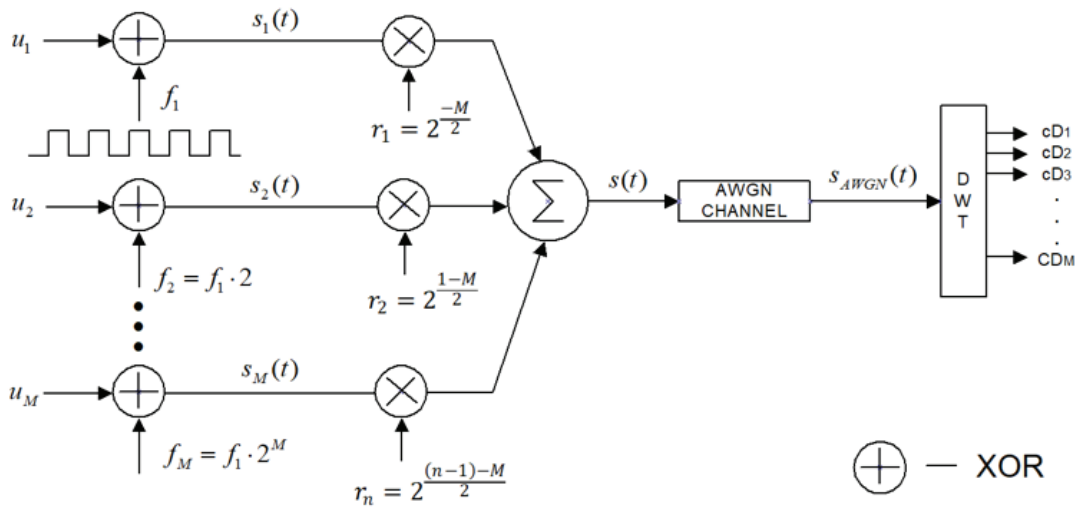

Figure 9.
MCOFDM scheme.

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Two computer simulations were carried out. Both simulations use 8 subchannels (M=8) with the total of 511 random bits (first subchannel – 1bit, second subchannel – 2 bits, third subchannel – 4 bits...) and 20.000 iterations are processed, every time with different input data. The first computer simulation results (normalization factors $r_{1...M}$=1) showed that the errors were not distributed evenly over all subchannels. The subchannels with a higher ordinal number have a greater number of errors. The blue curve in Figure 10 shows BER performance for OFDM based on Manchester code and Haar wavelet over AWGN channel without normalization.

To ensure even distribution of errors over the subchannels it is necessary to reduce the amplitude of the signal in the lower order subchannels and to increase it in the higher order subchannel. Therefore, the total power of the signal would remain the same. Hence, the expression (8) has to be overwritten by inserting a normalization factors

$$r_n = 2^{\frac{(n-1)-M}{2}} \tag{10}$$

where n is a channel number and M is the total number of channels.

Finally, the OFDM signal based on orthogonal coding using the Manchester code and Haar wavelet with normalization is defined using Eq. (11):

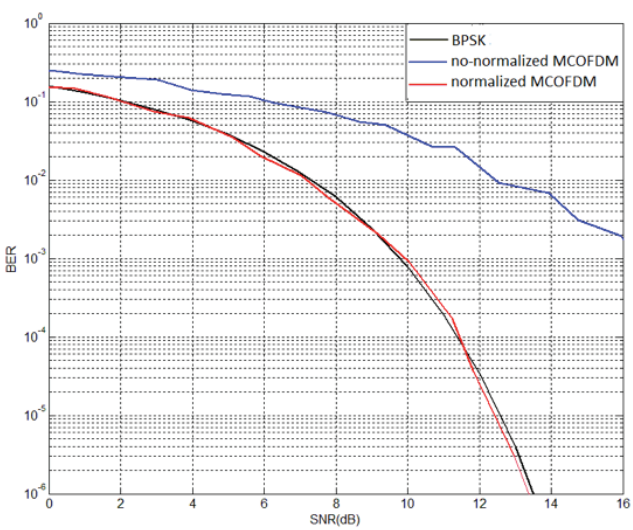

Figure 10.
BER performance over AWGN channel for BPSK, normalized and no-normalized OFDM based on Manchester code and Haar wavelet .

$$s(t) = \sum_{n=1} 2^{\frac{(n-1)-M}{2}} \sum_{i=0} \psi\left(\frac{t-i}{2^{1-n}}\right) \cdot [2 \cdot u_{n,i} - 1] \tag{11}$$

and the result of second computer simulation (BER performance for MCOFDM over AWGN channel with normalization) is shown in the red curve in Figure 10. For comparison purpose, the black curve shows theoretical BER performance for BPSK over AWGN channel (Soniwal, 2018).

7. CONCLUSIONS

The main advantage of amplitude digital modulation technique like ASK is simplicity, but it is very susceptible to noise interference due to noise affects the amplitude. Therefore, ASK is not used in OFDM and generally neither in any noise affected systems. PSK is less susceptible to errors than ASK. It occupies the same bandwidth, but a main disadvantage of PSK is more complex signal detection and recovery process. Moreover, QAM as the combination of PSK and ASK is even more complex than PSK. Although orthogonal coding uses amplitude digital modulation technique, this paper shows that BER performance of OFDM based on orthogonal coding using Manchester code and Haar wavelet are commensurable with BPSK or DMWT based OFDM in the presence of AWGN.

Furthermore, although the normalization procedure improves the BER performance, it should be noted that the decision if it should be used or not depends on the application. For example, if the raw data is transmitted over subchannels, the signals should be normalized. However, if audio and video are transmitted separately, the audio should be transmitted over lower order subchannels due to their noise insensitivity and video should be transmitted over higher order subchannels due to their larger width and higher capacity. If this situation occurs, the benefit achieved by normalization is questionable. Additionally, if the application requires equal subchannel widths, it is worth to explore the benefits of the PWT (packet wavelet transform) instead of DWT.

Finally, this paper clearly shows that a new DWT based OFDM algorithm significantly simplifies signal processing in the transmitter and receiver using no digital modulation of subcarriers in the receiver, neither IDWT in the transmitter. Although the signal transmission is achieved using amplitude modulation, the paper shows that BER performance is commensurable to BPSK or DMWT based OFDM in the presence of AWGN.

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EDD – Economic Benefit Analysis of Extending Dry Docking Interval

Dragan Bebić[a], Ladislav Stazić[b], Antonija Mišura[b], Ivan Komar[b]

The possibility of interval extension between two dry docking is alternatively offered to the shipowners by classification societies. Although, for now, such a possibility is limited only to certain types of ships, a significant shift has been accomplished in accordance with today's technical and technological capacities. It is quite clear that not all shipowners will accept this option, as either five-year or even mid-interval might suit them well. The option introduces an economic benefit, but requires additional preparation to withstand the full interval without negative consequences, primarily related to the protection of underwater part of the hull. The relationship of economic benefits and the cost of investment to successfully pass the complete period gives a clear view to the shipowner for the decision of accepting an extended dry docking period between two consecutive dry dockings. This paper is presenting one of the approaches to calculate feasibility of prolonging dry docking interval. Calculation example represents an economic indicator, crucial for shipowner's decision to accept prolonged dry docking interval. The paper presents an analysis of underwater hull condition for the vessel with a composite coating. It is based on a collection of actual data registered in the period of seven years. Significant data have been derived from the analysis, allowing basic set up for theoretical assessment as well as the real justification of extended dry docking period between two consecutive dry dockings of the vessel. Some of the presented facts, related to underwater composite coating, might be used for similar calculations.

KEY WORDS
~ Extending dry docking interval (EDD)
~ Composite coating, Underwater cleaning
~ Fuel consumption
~ Dry docking

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1. INTRODUCTION

Dry docking of the ship is an integral part of the regular maintenance of underwater hull, propeller, bow-thruster, sea water chests, cathodic protection of the hull, rudder, etc. Regular inspections in dry docks are specified by the IMO and classification societies, and they are usually accommodated within interval two and a half and five years. With the occurrence of the possibility to extend docking interval to the period of seven and a half years, although applicable only for certain types of vessels, a discussion opens in which interested sides present arguments for and against, to reconcile opinions. Namely, it is indisputable that today's technology enables most of the inspections and the repairs of the ship's underwater hull in a floating condition (Hydrex Underwater technology, 2012), and accordingly, it is quite justified to introduce extended docking interval. Viewing from the side of the ship-owner docking is "necessary evil", considering that the ship makes the profit only when sailing, the time spent in the dock, aside of maintenance costs, includes the costs of deviation to the shipyard as well as the costs of lost profits while staying in the shipyard. However, the counter-arguments are related to the application of a high-quality underwater coating, and protection against the growth of the marine organisms. The efficiency of the ship's underwater hull coating is quite challenging for the five-year interval of

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docking, and the extended interval additionally complicates the problem. Any mistake in the selection of underwater coating, manifested by increase of underwater hull fouling (Kovanen, 2012), is rapidly coming to the forefront in the form of increased fuel consumption, and accordingly, the increase in emissions of harmful gases, as well as the possibility of translocation of invasive marine organisms (Bodilis et al., 2012). This paper deals with the extended interval of docking based on the analysis of actual data from the field.

2. EXPERIMENTAL

2.1. Extended dry docking interval (EDD), the class requirements

Prolonged dry docking interval (Figure 1), although in the pilot phase, offers potential economic benefits to the shipowners by extending the range to seven and half years (Det Norske Veritas AS., 2012). However, it should note that it is necessary to consider an option as a package, with its "pro at contra." Apart from the savings, many possible problems are involved which needs to be considered. For now, the extended interval is primarily reserved for container ships in international sailing. The main problem of the prolonged docking interval is the adequate protection of the underwater hull as well as effective control of marine organisms fouling. The leading suppliers of marine coatings offer proven quality coatings that can withstand prolonged intervals without significant fouling of underwater hull, provided the sailing conditions, used for the calculation of dry film thickness, do not change significantly during the entire sailing period. Specifically, the thickness of the coating is estimated considering the amount and the rate of biocide release calculated concerning the speed of the ship, average sea temperature in the sailing area, and average time spent in the ports and anchorages. Significant deviation from the calculated conditions can result in increased or reduced biocidal consumption, which over the time contributes to inadequate protection against marine organisms fouling. If noticeable hull fouling has already occurred, resulting in significantly increased fuel consumption, underwater hull cleaning is an option to be considered (except for polymers based coatings). However, underwater cleaning process will usually take away a portion of biocide layer, which will reduce the duration of the bio-fouling protection of the hull. The exceptions are solid underwater coatings that do not contain any biocides. For them regular underwater cleaning of the hull is for these coatings the only way to control marine growth on the hull. The concept of these coatings relates to high ecological standards of safeguarding of the marine environment (Hydrex Underwater Technology, 2011). This paper analyses sailing interval of the vessel on which such a coating protects the underwater hull. A conventional type of stern tube could also be a problem at an extended interval, especially when considering the still unknown impact of EAL (Environmentally Acceptable Lubricants) on new sealing materials. New lubricants are in use, among other causes, due to the new rules VGP 2013 (EPA, 2013) issued by EPA (United States Environmental Protection Agency), which among controls of the effluents require ships to use EAL for stern tube bearings. Nevertheless, today there are completely green solutions of stern tubes that do not encounter this problem. One of the solutions is the installation of "Thordon" stern tube with sea water lubricated bearings (Carter, 2009) or some other manufacturer (Wärtsilä Corporation, 2018), (Lagersmit Corporation, 2018).

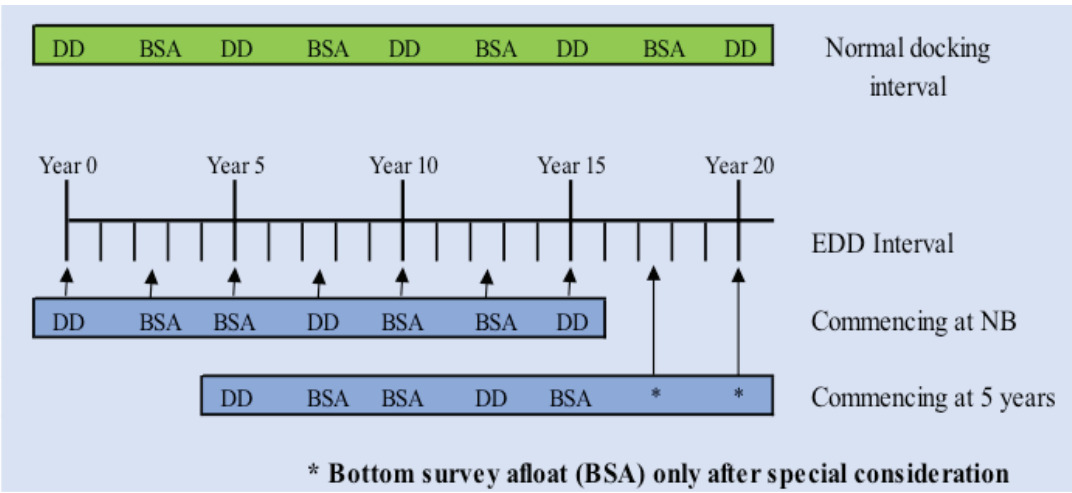

Figure 1.
Dry docking scheme (Det Norske Veritas AS., 2012).

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2.2 Analysis of extended period influence to the condition of the underwater hull

For the task of analysis of underwater hull condition and its influence on the fuel consumption (Molland et al., 2011) in the extended period between dockings, processing of the data has been done for the vessel of 42,276 DWT. Fuel consumption and vessel's speed data had been collected within the period from February 2010 to August 2017. In this period, the vessel completed two dockings, 2011 and 2015. Surface treated composite coating had been applied to the underwater hull, for the first time in 2011, classified as STC (Surface Treated Composite) coating that neither contains nor release biocides, thus regular underwater cleaning is the only way to control fouling of the hull. During the second docking, 10% of the total coated area has been renewed on the flat bottom, vertical sides and bootop. It has to be noted that vessel's permanent trade is Nord Europe – Canada and that during winter period the coating is exposed to the mechanical damages by ice. Taking into consideration such severe condition, mentioned the percentage of the renewed coating is rather minimal. Presented graph (Figure 2) summarizes all data of fuel consumption and vessel's speed within the period 2010-2017.

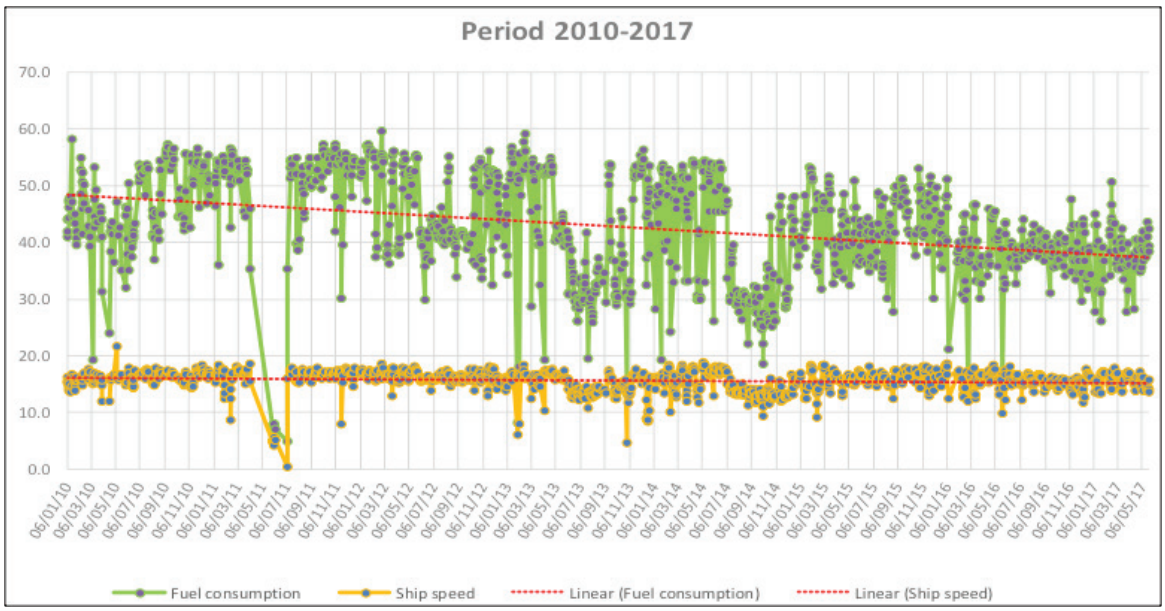

Figure 2.
Complete data for fuel consumption and ship speed in period 2010-2017.

Presented trends of fuel consumption and speed are linear, calculated by standard "Excel" functions. Linear equation for fuel consumption trend is:

$$y = -0.0041\,x + 214.36 \quad (1)$$

where:
x - quantity of the fuel for the specified date.

Accordingly, the regression coefficient of determination (Note: The specific indicator of regression reliability is coefficient of determination R^2 that is, based on Chaddock's scale, within the range 0.0-1.0. The regression model is getting more reliable when the ratio of determination is closing value 1.0.) for fuel consumption (R^2=0.1274) has been calculated. Based on Chaddock's scale (Table 1), its value is within range for low correlation, and thus linear trend of fuel consumption is not reliable for fuel consumption prediction outside the observed interval.

Table 1.
Chaddock's scale (Moore et al., 2014).

R^2	Irl	Explanation
0	0	Negligible correlation
0.00-0.25	0.00-0.50	Low correlation
0.25-0.64	0.50-0.80	Moderate correlation
0.64-1	0.80-1.0	High correlation
1	1	Very high correlation

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By using the same procedure, the equation of the linear trend of the ship speed and the regression coefficient of determination was obtained. Linear equation for ship speed trend is:

$$y = -0.0003\,x + 28.233 \quad (2)$$

where:
x - quantity of the fuel for the specified date.

The Regression coefficient of determination for speed data is 0.0152.

Again, in case of ship's speed there is a weak connection data with the linear trend, even in this case, the pattern does not have enough accuracy for the speed prediction outside graph timeline. Anyhow, the intention of the paper is not to deal with the time prediction of consumption/speed of the ship, but with general direction of the trends during the observed data period. Therefore, a small value of the regression coefficient is acceptable. However, it should be taken into account that the graph (Figure 2) does not give a realistic picture as fuel consumption varies widely, due to the different sailing conditions:

- State of the substantial sea,
- Default full speed.
- Default economic speed
- Default super-economic speed

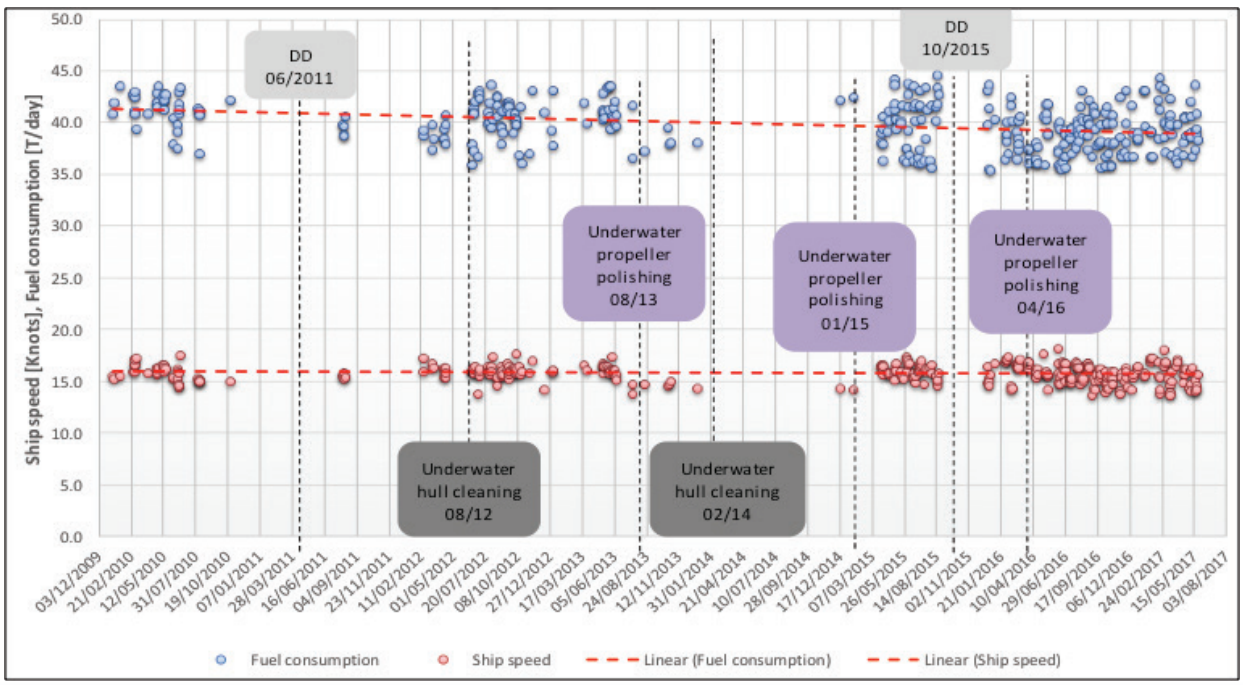

Figure 3.
Fuel consumption and speed data for ECO sailing regime in period 2010-2017.

Therefore, it is necessary to eliminate the data collected regarding heavy sea and choose one of the defaults sailing regimes throughout the interval 2010-2017. Data for navigating with economic speed are the most numerous, and it is quite logical to analyze these data.

Figure 3 shows only data for ECO (economical sailing speed) navigation, to better analyze the trend of speed and consumption (Kovanen, 2012). There are apparently defined time periods for maintenance of underwater hull and propeller, components that directly affect ship speed and fuel consumption (Logan, 2012).

3. DISCUSSION

The graphs are presented to determine the trends of fuel consumption and ship speed (International Organization for Standardization, 2016) in the indicated specified period to find out whether it is possible to extend the interval between the two dockings without significant loss of ship speed or increase in fuel consumption at the end of the extended range. In this case, ship speed is kept constant, so the change in fuel consumption is variable which characterizes economy of sailing. In this

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sense, at first glance, it is entirely illogical that the trend of fuel consumption tends to fall on all graphs. It is expected that the fuel consumption trend have a slight increase towards the end of the extended interval. Namely, since this underwater coating is hard and does not damage by underwater cleaning, the rotation of brushes to cleanse the collected marine organisms also polishes the underwater coat, and after each underwater cleaning, the roughness of the underwater coating becomes reduced.

For a rough estimate of fuel savings over the processing time, data from Figure 4 is used. The "Ton-Mile" trend starts with a value of 1.08 and ends with a value of 1.04.

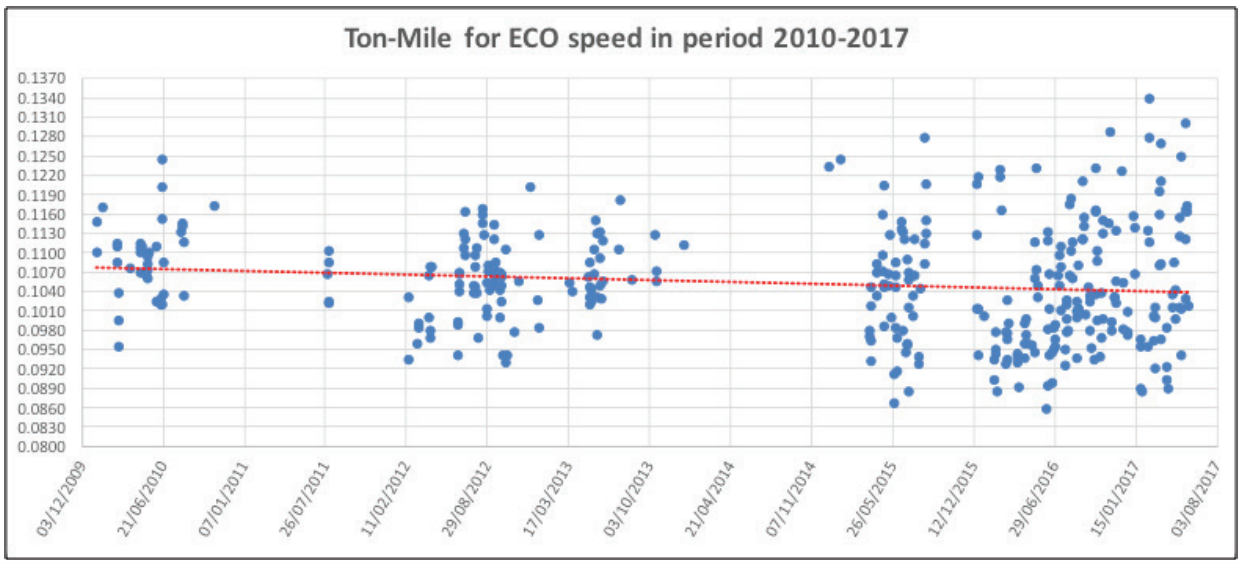

Figure 4.
Sailing distance in NM per one ton of consumed fuel.

From this, daily fuel consumption is calculated, considering that the "ton-mile" data used the average ship speed 15.8 knots.

$$"Ton - mile" = \frac{Daily\ fuel\ consumption}{Total\ daily\ distance\ sailed} \quad (3)$$

By adding known values, the daily fuel consumption is:

$$0.108 = \frac{x}{378.9} \quad (4)$$

As per (4) daily fuel consumption at the beginning of the period is 40.9 T/day. By the same process, daily fuel consumption at the end of the period found to be 39.4 T/day.

In the case of quality classical biocide-releasing coatings, the average drop in ship speed at the end of the five-year period ranges from 0.5-0.8 %. As data for the vessel with a classical biocide-releasing coating is not available, comparison of two types of layers is not feasible. Therefore, the best possible case for the classic coating will be surmised, without speed drop and increased fuel consumption over the observed period that is based on average 252 sailing days per year for period 2010-2017. Figure 5 shows such a hypothetical example. A decrease in fuel consumption in the ship with a composite underwater coating is simplified and displayed linearly. At the very end of the period, the fuel consumption of the vessel with a composite marine coating is 3.67 % lower than the ship with a classic underwater coat.

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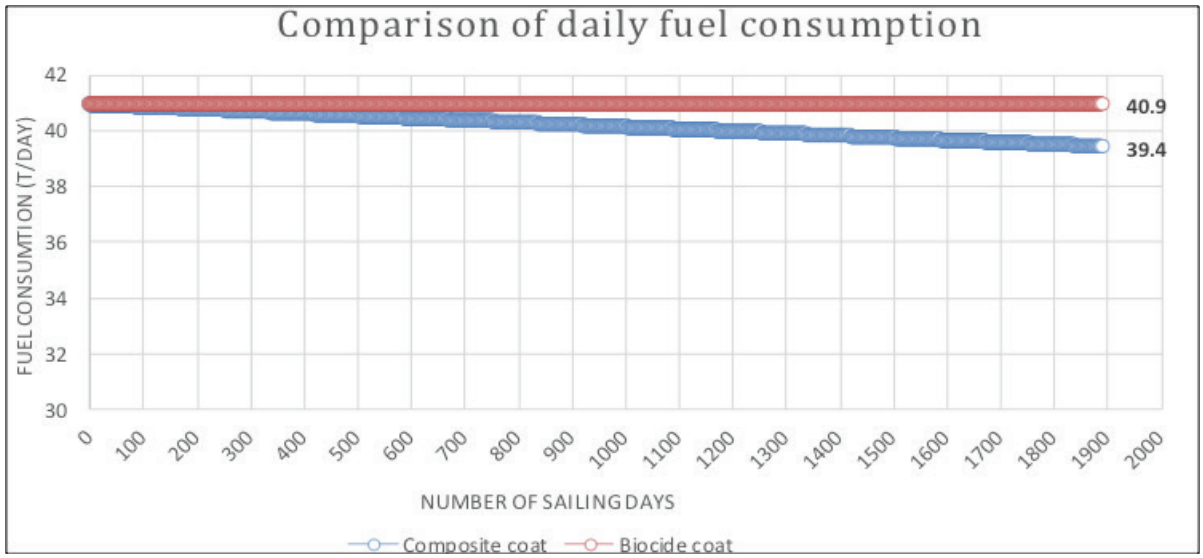

Figure 5.
Comparison of daily fuel consumption for vessels with composite and biocide coatings.

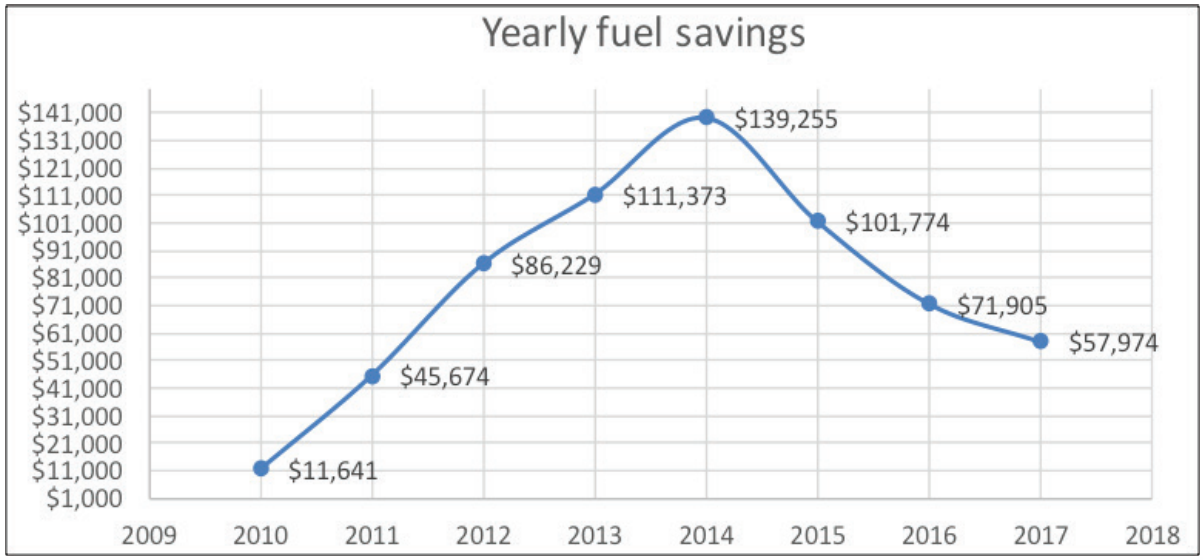

Figure 6.
Calculation of fuel savings for the ship with a composite underwater coating in relation to the fuel consumption of the ship with a classic coating.

For Figure 6, the assumption of a linear reduction in fuel consumption was used, starting from the initial consumption of 40.9 T/day to consuming 39.4 T/day at the end of the observed period. The calculation is based on the average fuel prices on the world market, as shown in Table 2.

During the observed seven-and-a-half year, total fuel savings on the vessel with a composite coating compared to the ship with a classic underwater layer is 1.62 % or $625,825.00. Comparative Table 3 greatly gives precedence to the vessel with a composite coat and confirms that the prolongation of the docking interval, in this case, is feasible and economically beneficial. However, it should be emphasized that a good part of the calculation is in the sphere of assumptions; thus, the conclusion has only theoretical potential.

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Table 2.
Fuel prices during observed period.

Average yearly fuel price at the world market	Observed period	Source
US 487.48	1st Oct 2009 – 1st Oct 2010	LQM Petroleum Services, Inc.
US 606.56	1st Oct 2010 – 1st Oct 2011	LQM Petroleum Services, Inc.
US 686.00	1st Oct 2011 – 1st Oct 2012	LQM Petroleum Services, Inc.
US 632.44	1st Oct 2012 – 1st Oct 2013	LQM Petroleum Services, Inc.
US 614.81	1st Oct 2013 – 1st Oct 2014	LQM Petroleum Services, Inc.
US 367.55	1st Oct 2014 – 1st Oct 2015	ClearLynx LLC
US 219.69	1st Oct 2015 – 1st Oct 2016	ClearLynx LLC
US 314.99	1st Oct 2016 – 1st Oct 2017	ClearLynx LLC

The following assumptions have been used in this paper:

1. For the vessel with classical underwater coating

a. Data for ship speed and fuel consumption during the observed period were not available, so experience data applied (rebuilding underwater coating after five years).

b. It is incorrect assumption that there is no increased fuel consumption throughout the period. Most manufacturers, for quality classical coats, specify the average speed drop rate of 0.5-0.8 % at the end of the interval. Incorporating the value of increased fuel consumption would additionally increase the overall cost of the ship with the classic coating in comparison with the vessel with a composite underwater layer.

Table 3.
Comparison of maintenance costs for underwater hull for the vessels with classical coating and the composite coating.

		Initial docking	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	End of period
The vessel with clasical biocide coating	Cost for coating	$120,000					$100,000			
	Lost of profit due to 12 days in SY ($22,000/dan)	$264,000					$264,000			
	Cost of increased fuel consumption due to hull fouing									
	Total cost in observed period					$748,000				
The vessel with composite coating	Cost for coating	$285,000					$40,000			
	Lost of profit due to 12 days in SY ($22,000/dan)	$264,000					264,000			
	Cost for underwater hull cleaning		$30,000			$30,000	$30,000			
	Fuel consumption savings due to hull cleaning		**$11,641**	**$45,674**	**$86,229**	**$111,373**	**$139,255**	**$101,774**	**$71,905**	**$57,974**
	Total cost in observed period					$317,175				

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2. For the vessel with composite underwater coating

a. The assumption is that the ship will retain the same performances and without second docking in 2015 (the assumption based on the trend).

b. The hull cleaning frequency is the actual data, but in some other sailing areas, such rate would not be sustainable without significant fouling of the hull.

c. The lost profit due to time spent in the dock was in the calculation (actually there was), but in the extended interval, this cost does not exist.

Considering limited number of underwater hull cleanings (Table 3), a new Table 4 was created with the more realistic frequencies of underwater cleaning over the entire observed period.

Table 4.
Costs of maintaining a composite coating in case of increasing underwater cleaning frequency.

		Initial docking	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	End of period
Cost for composite coat maintenance (underwater hull cleaning every 12 months)	Cost for coating	$285,000					$100,000			
	Lost of profit due to 12 days in SY ($22,000/dan)	$264,000					$264,000			
	Cost for underwater hull cleaning		$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000
	Fuel consumption savings due to hull cleaning		**$11,641**	**$45,674**	**$86,229**	**$111,373**	**$139,255**	**$101,774**	**$71,905**	**$57,974**
	Total cost in observed period					$163,175				
Cost for composite coat maintenance (underwater hull cleaning every 6 months)	Cost for coating	$285,000					$40,000			
	Lost of profit due to 12 days in SY ($22,000/dan)	$264,000					264,000			
	Cost for underwater hull cleaning		$60,000	$90,000	$60,000	$60,000	$60,000	$60,000	$60,000	$30,000
	Fuel consumption savings due to hull cleaning		**$11,641**	**$45,674**	**$86,229**	**$111,373**	**$139,255**	**$101,774**	**$71,905**	**$57,974**
	Total cost in observed period					$403,175				
Cost for composite coat maintenance (underwater hull cleaning every 4 months)	Cost for coating	$285,000								
	Lost of profit due to 12 days in SY ($22,000/dan)	$264,000								
	Cost for underwater hull cleaning		$90,000	$90,000	$90,000	$90,000	$90,000	$90,000	$90,000	$30,000
	Fuel consumption savings due to hull cleaning		**$11,641**	**$45,674**	**$86,229**	**$111,373**	**$139,255**	**$101,774**	**$71,905**	**$57,974**
	Total cost in observed period					$583,175				

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Table 4 presents three frequencies of hull cleaning that, based on experiential data, could be applied in the case of cold seas (12 months), combined sailing areas (6 months), and tropical seas (4 months). In all cases, the extended interval shows significant savings over the standard five-year docking period. These savings are:

- In the case of hull cleaning every 12 months, the total savings in the observed period for a ship with the composite underwater coating compared to the classic hull coat would amount to $ 584,825.
- In the case of hull cleaning every 6 months, the total savings in the observed period for a ship with the composite underwater coating compared to the classic hull coat would amount to $344,825.
- In the case of hull cleaning every 4 months, the total savings in the observed period for a ship with the composite underwater coating compared to the classic hull coat would amount to $164,825.

4. CONCLUSION

A prolonged interval between the two dockings is the option offered by classification societies. It is quite clear that there will be contradictory opinions among shipowners, primarily related to the economic viability of the transition to an extended interval. Although this paper undoubtedly proved the economic viability of the change to the prolonged interval, the particularities of each case should account. For example, use of composite underwater coatings requires regular underwater cleaning as it is the only way to control the growth of marine organisms. Therefore, underwater cleaning should be available in the vessel's trading areas, according to maintenance plan of the hull. Unfortunately, the availability of ports that allows "classic" underwater cleaning is limited. Under "classic" underwater cleaning, it is considered the use of cleaning tools that do not collect products of cleaning, but they remain in the marine environment of the port. For a good reason this type of underwater cleaning become strictly prohibited in most of the ports around the world since, besides contamination of biocides from marine coatings, there is a great danger in the transmission of invasive marine organisms. However, this does not mean that underwater cleansing will be banished, on the contrary, underwater cleaning is a necessity as more and more ports do not accommodate vessels alongside if they have excessive hull fouling. Those vessels are forced to perform underwater hull cleaning before they can get alongside. However, this type of underwater cleaning means that all products of cleansing should collected and safely disposed outside marine environment. Unfortunately, such technology is not widely available, and this can be one of the arguments against the use of composite underwater coatings. In the case of biocidal coatings for an extended interval, which are not a unique brand of the coats, but conventional marine coating with an increased DFT (dry fil thickness), calculated to withstand extended interval. Most of the biocide underwater coat manufacturers have reserve towards a prolonged interval just because of the increased DFT, because with a significant increase in the thickness of the layer, the elasticity decreases and the possibility of cracking occurs and ultimately partial or complete destruction of the underwater coating of the hull is a likelihood. Considering all the above the extended interval has the potential of economic justification, but the process of deciding to switch to a prolonged interval must be well conceived and comprehensive in the analysis of all costs. Of great significance, for making the final decision, could be an analysis of the area and conditions of navigation of each ship separately.

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Valuation of Transport Service Characteristics Relevant for the Establishment of Fast Inter-City Lines in Sea-Borne Passenger Traffic

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This paper analyses and evaluates major characteristics of transport services relevant for the organization of fast inter-city lines in maritime passenger transport. Service characteristics that have been subjected to research and assessment include: 1) individual travel costs, 2) travel duration, 3) travel safety, 4) social costs of transport, 5) ability to create a traffic service and 6) other elements of the traffic service. Using descriptive statistics and growth matrix, the analysis reveals that the *Ability to create a traffic service* and *Travel duration*, both having direct growth rates of 75 %, will have the largest impact on the establishment of fast inter-city sea-borne lines, followed by the Social costs of transport with the direct growth rate of 68.42 %. The impact of other transport service characteristics on the organization of fast inter-city lines in maritime passenger transport is estimated as moderate.

KEY WORDS

~ Maritime passenger transport
~ Transport services
~ Fast vessel inter-city lines

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1. INTRODUCTION

The transport and maritime policies of the Republic of Croatia contain strategic development guidelines that rather loosely define the need to strike a balance between different transportation systems, which is necessary for the improvement of the transport network, traffic safety, environmental conditions, travel duration and, in particular, given the fact that Croatia has become a full member of the European Union in which finding a balance between traffic modes is one of key transport policy objectives. Europe's maritime interests mostly revolve around the welfare, prosperity and security of its citizens and communities (Moise, 2015). In this respect, Croatia's efforts to introduce inter-city maritime transport are insufficient in cargo trade and very poor in passenger traffic, although the latter is deemed to have great potential. The establishment of fast sea-borne passenger traffic along Croatia's coastline would considerably relieve road traffic and contribute to the realisation of the objectives of transport and maritime policies, especially in case of active introduction of short-haul routes which are crucial for a better valuation and usage of sea for transportation. Maritime transportation, similar to land and air transportation, unfolds in its own space, which is simultaneously geographical by its physical attributes, strategic by its control and commercial by its usage. While geographical considerations tend to be constant in time, strategic and especially commercial considerations are much more dynamic (Serap and Guler, 2007). The organisation of fast coastal inter-city runs in the framework of the national maritime and traffic system would contribute to the improvement of the traffic system

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across the nation and generate a number of benefits which would balance different modes of transport. Although maritime infrastructural framework exists (fairways, seaports), there is a lack of quality entrepreneurial concepts which would allow the existing potentials to be realized. One of possible concepts is the introduction of fast inter-city passenger vessels.

In this respect, the main purposes of this study are the analysis of the basic characteristics of the transport service in sea-borne passenger traffic, and the scientific examination of the information and insights obtained to assess the importance of these characteristics for the establishment of fast inter-city passenger vessels in Croatian coastal waters. The research, formulation and presentation of research results in this paper are based on scientific methods, including analysis and synthesis, abstraction and concretisation, descriptive statistics and growth matrix as one of the valuable tools for the evaluation of the transport service characteristics relevant for the organization of fast inter-city lines in maritime passenger transport in the Republic of Croatia.

2. THEORETICAL FRAMEWORK

According to the World Tourism Organization (Tourism highlights, Madrid, 2011), road transport accounts for 51 % of international tourist arrivals. As for Croatia, the road share in tourist transport is considerably higher: around 70 per cent of foreign tourists come to Croatia by road (Jurčević, Madunić, Tolušić, 2006). The road transport share in tourism is somewhat lower along the shores of Dalmatia where three international airports (Zadar, Split and Dubrovnik) operate on a year-round basis, but the share of sea-borne transport remains marginal in all aspects (Kovačić and Milošević, 2016). Given the fact that Croatia's Gross Domestic Product (GDP) heavily depends on tourism, with travel and tourism directly contributing with 10 % and indirectly to over 23 % in 2015 and expected to increase to 30 % by 2026 (World Travel & Tourism Council, 2016), with most of the growth expected on the coastline and islands, the current predominance of road transport in Croatia is obviously not sustainable in the long run. The existing situation and forecasts require the defining and implementation of a proactive traffic and shipping policy aimed at reducing the share of road traffic, particularly toward and around major coastal tourist destinations. Slight changes are already taking place. The analysis of passenger transport trends in Croatia has confirmed that sea-borne passenger transport has been increasing slowly but almost steadily over the years (Pupavac et al., 2015). The growth was halted only during the Homeland War (1991-1995) and slowed down during the recent global economic crisis that deeply affected the country (Figure 1).

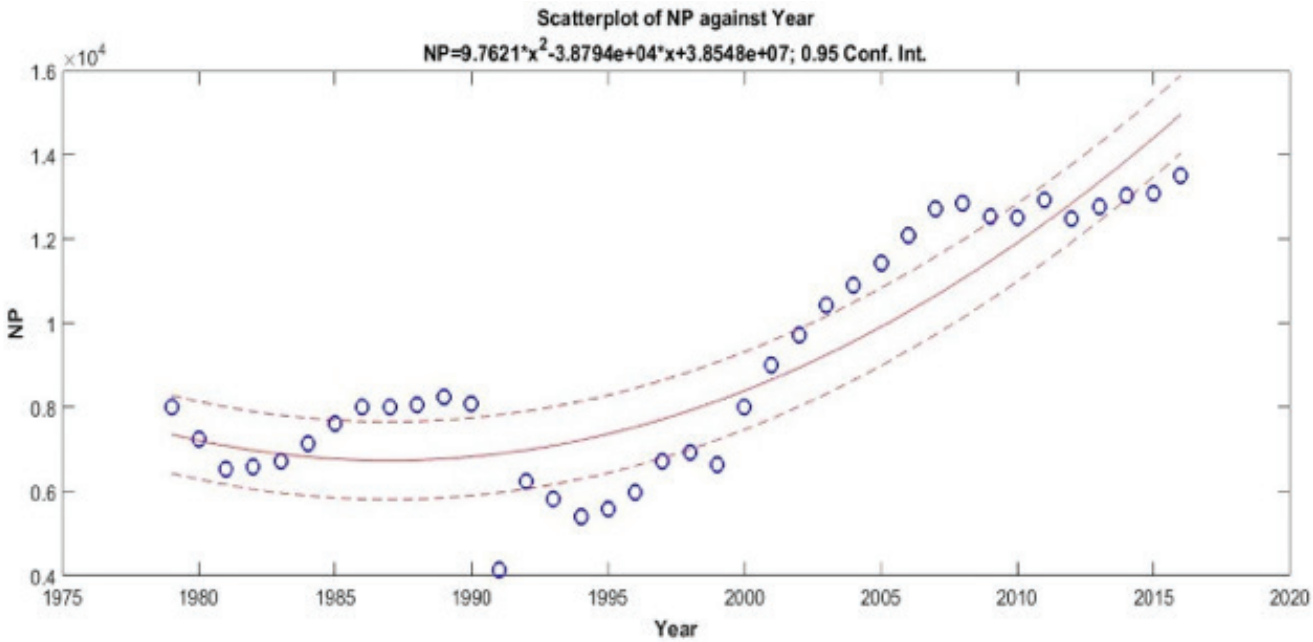

Figure 1.
Number of passengers served by Croatian seaports 1979 – 2013 (Source: authors, according to Statistical Yearbook of the Republic of Croatia, various years).

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A short descriptive analysis (cf. Table 1) indicates that Croatian sea ports served 343,843,000 passengers over the observed period, i.e. the average of 9,048,500 passengers per year (SD: 2,808,600).

The lowest number of passengers transported in Croatian maritime passenger traffic in the observed period was 4,138 million passengers in 1991, while the largest number of passengers were carried in 2013 when 13,11 million passengers were transported. The analysis has confirmed both the continuous interest of users and the stamina of sea-borne passenger transport in Croatian waters.

Table 1.
Descriptive analysis of passenger traffic in Croatia's seaports from 1979 to 2013.

	No. of passengers
MEAN case 1-35	9,048.5
MEDIAN case 1-35	8,040
SD case 1-35	2,808.6
VALID_N case 1-35	38
SUM case 1-35	343,843
MIN case 1-35	4,138
MAX case 1-35	13,525

The figures can be improved further by establishing fast passenger shipping routes along the coastline. In this way, sea shipping companies would contribute to the implementation of the objectives of the national traffic and maritime policies and considerably boost Croatia's passenger shipping and maritime economy in general. Sea-borne coastal services would positively affect the national maritime and traffic system in terms of traffic mode balance. The existing system of sixteen fast passenger lines that connect coastal cities with the islands experiences a continuous increase in passenger turnover. It is therefore reasonable to assume that further development of similar inshore services would bring new benefits to the nation's traffic system (Sabolović, 2002). Further development of fast passenger shipping service may also result in a more adequate evaluation of maritime passenger transport as an alternative to road transport along the eastern Adriatic coast. As a result, passenger transport flow would be redirected from the mainland to the sea, facilitating the introduction of new modes and forms of transport. Benvenuto et al (1996) propose the introduction of a new sea passenger line serviced by innovative high speed vessels (SES) in the metropolitan area round Genoa. Chen et al (2017) point out that urban ferry system can carry a large number of travellers, which may alleviate the pressure on road traffic. According to them, service time reliability plays an essential part in attracting travellers to the ferry system.

The implementation of a fast inter-port passenger service seems to be a sound strategic move both in national and international sea-borne passenger traffic. In national waters, this would imply the networking of coastal towns that have developed around important seaports: Pula, Rijeka, Zadar, Šibenik, Split, Ploče and Dubrovnik. Fast passenger liners could further connect these towns with major tourist destinations such as Rovinj, Poreč, Biograd, Makarska and other towns during tourist season. This would clearly increase the spatial mobility of tourists and local population and reduce the seasonality of Croatia's maritime passenger transport. As for international transport, fast lines between the above mentioned Croatian ports and the coastal towns in Italy, Montenegro, Albania and Slovenia should be established. The establishment of these fast lines would have an economic multiplier effect, as it would contribute to further integration of Croatia with the European Union and facilitate the accession of Montenegro and Albania to the European Union.

The assessment of the economic justifiability of the establishment of fast vessel passenger lines requires factors affecting passenger traffic flows, such as (Pupavac, 2009): 1) demographic factors, 2) the standard of living, 3) tourist sojourn, 4) institutional features, 5) size, type and spatial distribution of production and trade centres, 6) voyage time in maritime passenger transport, and 7) individual costs in maritime passenger transport to be defined. Then, essential transport service characteristics through which users access a specific mode of transport and which are, simultaneously, suitable for evaluation using the growth matrix need to be defined. Five major characteristics have been obtained (Plazibat et al., 2015), as follows: Individual travel costs, Travel duration, Transport safety, Social costs of transport, and Ability to create a traffic service.

3. METHODOLOGICAL APPROACH

A scientifically established assumption implies that the transport service in sea-borne passenger traffic consists of "n" inter-reliant characteristics (elements). The value (e.g. an input) of an *i* characteristic of the maritime passenger transport service (i = 1, …, n) is expressed as y_{it} and $y_{i,t-1}$ during the periods *t* and *t-1*. A growth of the input value of the *i* characteristic of the maritime passenger transport service is expressed as:

$$\Delta y_{it} = y_{it} - y_{it-1} \quad (1)$$

An indirect growth rate of the *i* characteristic of the maritime passenger transport service, in relation to *j*, is defined as relation between the input growth of the *i* characteristic of the sea-borne passenger transport service Δy_{it}, and the input value of the *j* characteristic of the maritime passenger transport service:

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$$r_{ijt} = \frac{y_{it}}{y_{jt}} \qquad i,j = 0,\ldots,n \qquad y_{jt} \neq 0 \tag{2}$$

The indirect growth rates can be expressed as a growth matrix that is based on the values of the transport service characteristics in the sea-borne passenger transport (Stojanović, 1999):

$$R_t = \begin{bmatrix} r_{11} & r_{12} & \ldots & r_{1nt} \\ r_{21} & r_{22} & \ldots & r_{2nt} \\ \ldots & \ldots & \ldots & \ldots \\ r_{n1t} & r_{n2t} & \ldots & r_{nnt} \end{bmatrix} \quad t = 1,\ldots,T \tag{3}$$

where the elements on the main vertical refer to direct growth rates ($i = j$), while the others refer to indirect growth rates ($i \neq j$). The elements in the i row refer to the input growth in the i characteristic of the transport service in sea-borne passenger traffic in relation to the values of other characteristics. The items in the i column refer to the growth of the input value of all characteristics of the sea-borne passenger transport service during the period t. Therefore, every characteristic of the sea-borne passenger transport service in the growth matrix is represented by one row and one column, with elements expressing indirect or relative growth relationships. For example, the first row indicates the input growth of the first characteristic of the sea-borne passenger transport service in relation to other characteristics, whereas the first column indicates the growth of the remaining characteristics of the maritime passenger transport service in relation to the input of the first characteristic of the transport service in sea-borne passenger traffic. The remaining rows and columns refer to the remaining transport service characteristics of the sea-borne passenger transport.

The indirect growth rates can be described with regard to the inputs of the j characteristic of the maritime passenger transport service in the period t=1:

$$r'_{ijt} = \frac{\Delta y_{it}}{\Delta y_{j,\,t-1}} \qquad i,j = 0,\ldots,n \tag{4}$$

The connection between indirect growth rates (2) and (4) can be established through the following inter-relations:

$$\left.\begin{aligned} r_{ijt} &= r'_{ijt} / 1 + r'_{jjt} \\ r'_{ijt} &= r_{ijt} / 1 - r'_{jjt} \end{aligned}\right\} \qquad i,j = 1,\ldots,n \tag{5}$$

The growth matrix can be determined through the external vector of the characteristics of the maritime passenger transport service (Zelenika and Pupavac, 2008). This way of determining the matrix is useful in practical calculation of its growth. The vector describing the growth of the transport service characteristics' values in the sea-borne passenger transport can be expressed as:

$$\Delta y_{it} = \Delta y_{1t},\ldots,\Delta y_{mt} \tag{6}$$

The vector of the reciprocal values of the maritime passenger transport service characteristics is defined as:

$$\left(\frac{1}{y_t}\right) = \left(\frac{1}{y_{1t}}\right),\ldots,\left(\frac{1}{y_{nt}}\right) \qquad i,j = 0,\ldots,n \qquad y_{it} \neq 0 \tag{7}$$

The growth matrix of the values of sea-borne passenger transport service characteristics is defined by the external value of the growth vector and of the vector of the reciprocal values of the maritime passenger transport service characteristics (Stojanović, 1990).

$$R_{pt} = \Delta y'_t \frac{1}{y_t} = \begin{bmatrix} \Delta y_{1t} \\ \vdots \\ \Delta y_{mt} \end{bmatrix} \left(\frac{1}{y_{1t}},\ldots,\frac{1}{\Delta y_{nt}}\right) \tag{8}$$

$$R_{pt} = \begin{bmatrix} \frac{\Delta y_{1t}}{y_{1t}} & \ldots & \frac{\Delta y_{1t}}{y_{nt}} \\ \ldots & \ldots & \ldots \\ \frac{\Delta y_{mt}}{y_{1t}} & \ldots & \frac{\Delta y_{mt}}{y_{nt}} \end{bmatrix} \begin{bmatrix} r_{11t} & \ldots & r_{1nt} \\ \ldots & \ldots & \ldots \\ r_{m1t} & \ldots & r_{mnt} \end{bmatrix} \tag{9}$$

If only direct growth rates are analysed, the growth of one characteristic of the transport service in sea-borne passenger traffic is expressed independently from the growth of the others. On the other hand, when analysing indirect growth rates, i.e. the growth of the i characteristic of the transport service in sea-borne passenger traffic in relation to j (i, j = 1, …, n), the structure of the growth of the importance of the characteristics can be determined and all relationships across the system expressed by the growth matrix.

If direct and indirect rates are expressed simultaneously, the changes of values of transport service characteristics in maritime passenger traffic, and their structural relationships can both be feasibly traced.

4. RESEARCH RESULTS AND DISCUSSION

The starting point in the evaluation of the importance of maritime service characteristics was 2008, when the "regular" seasonal fast line Pula – Zadar was established as a symbol

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of the idea of organization of fast inter-city routes in maritime passenger traffic. For the initial period (2008) the importance of the individual characteristics of maritime transport service was evaluated and rated by a value (index), i.e. by an input the value of which was assessed from a broader social viewpoint. After that, the growth of inputs for each characteristic of maritime transport service was anticipated for the year 2016. Finally, forecasts for the year 2025 were drawn up. The first observed period (2008-2016) was defined as the period when the idea of introducing inter-city passenger lines along Croatia's shores was developed. Although the period lasted eight years, it was not observed in the traditional context of long-term planning. Instead, it was rather observed as the period of exploration and introduction of fast sea-borne passenger lines in coastal inter-city traffic. The eight-year period was considered a reasonable timeframe to obtain insights into all benefits of introduction of inter-city lines in maritime passenger traffic before the complete liberalisation of the sea-borne passenger market. The next period (2016-2025) is anticipated to see not only the establishment of fast sea-borne passenger lines along Croatia's shores, but also the maturity of these products / services in terms of economic and social impacts.

The valuation of major characteristics of maritime transport service to quantify their influence on the organisation of fast sea-borne passenger lines, was performed as follows:

Safety in sea-borne passenger transport.

Maritime passenger transport is indisputably the safest mode of passenger transport. Accordingly, this element for 2008 is allocated a relatively high rated input of 60. As this characteristic of the transport service is insufficiently utilised, it is expected that the users will increasingly recognise this characteristic, i.e. that it will become increasingly important in the long run. Therefore, this characteristic of the transport service has a rated input of 90 for the year 2025.

Travel duration.

In maritime passenger transport, travel duration is a function consisting of three elements: 1) waiting time, 2) network access time, and 3) speed at sea. Overall travel duration is an exceptionally important characteristic of the transport service. This has been confirmed by the introduction of fast liners running between Croatia's inhabited islands and coast since 2000. However, the project has never evolved and has never been extended to meet the transportation needs along the coastline. Therefore, travel duration as a transport service characteristic for 2008 is allocated a relatively low rated input of 30. Since full valuation of the benefits of fast vessel inter-city lines for the reduction overall travel duration will result in increased importance of this characteristic, its rated input for 2025 is 80.

Individual travel costs in maritime passenger transport

Passenger's individual costs in maritime transport represent a complex function that includes expenses such as travel fares, access costs, parking charges, luggage transport fees, and added service costs. In terms of costs, sea-borne passenger traffic is very competitive in comparison with bus transport service. However, this is also one of the insufficiently evaluated transport service characteristics. There is a lack of inter-city routes in maritime transport and the sailing schedule is not adapted to tourist demand. These are the reasons for allocating a rated input of 50 to this transport service characteristic for 2008, whereas its rated input for 2025 is 85, when fast passenger inter-city coastal lines are expected to be fully established.

Social costs of transport in maritime passenger transport

Social costs are part of the total cost of maritime transport on the sailing route. These costs primarily refer to the construction of infrastructure as these investments are huge and produce a very slow rate of return, which makes all incentives for maritime infrastructure development economically justified. Since these costs have been largely ignored by various transport analyses, it is no surprise that a number of benefits of sea-borne passenger transport, compared to other forms of transport, have been bypassed. This is why the rated input of 30 was allocated to this transport service characteristic for 2008. Full EU membership allows Croatia to develop a better transport policy focusing on the sustainable development of transport, i.e. on the reduction of the social costs of transport and encouraging sea-borne passenger traffic. In this sense, this maritime transport characteristic has an exceptionally high rated input of 95 for the year 2025.

Ability to create maritime traffic service.

The ability of local shippers to create traffic services in the inter-city liner trade is rated with the lowest input of 20 for the year 2008. This poor rating can be attributed to the lack of appropriate fast vessels and the shippers' lack of vision and proactive policy with regard to impending changes in the national passenger market. The threat of competitors from the European Union is expected to increase the ability of Croatian shippers to create transport service, i.e. the overall readiness, flexibility, and capacity to maintain sailing schedules is expected to grow. Hence, this characteristic of the transport service has the rated input of 80 for 2025. A substantial growth of this input is also expected given the fact that fast vessels of 50-60 m in length carrying around 500 passengers have good sailing performance in typical sea conditions, in particular during winter, when the conditions commonly include fresh breeze (5 Bf) and rough seas (3-4 m).

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Other elements

Other elements of maritime traffic service include: seaports and passenger terminals, human resources and information technologies, which largely contribute to the quality of service in sea-borne passenger traffic. Recognising the importance of seaports in national and international passenger traffic, state and local authorities have completed or have been completing port infrastructure modernization projects, particularly in the ports of Rijeka, Ploče, Dubrovnik, Split, and Gaženica near Zadar. It is indisputable that Croatia's seaports are not an obstructing factor in the organization of fast passenger liner trade in maritime transport. The proficiency of human resources at all levels of maritime education, maritime tradition and the developed systems of sea shipping management ensure the provision of high-quality services. For these reasons, the rated input for this maritime transport characteristic is 60 for 2008, and 90 for 2025.

The results of the analysis of the relevant characteristics of the maritime passenger transport service are presented in Table 2.

Table 2.
Value of the characteristics with regard to the organization of fast inter-city routes.

No.	Characteristics of the service in maritime passenger traffic	Inputs Y_{it}			Growth
		2008	2016	2025	$\Delta y_{i,}$2025
1.	Transport safety	60	70	90	30
2.	Travel duration	30	50	80	60
3.	Individual travel costs	50	60	85	35
4.	Social costs of transport	30	55	95	65
5.	Ability to create the traffic service	20	45	80	60
6.	Other elements	70	80	90	20

The information presented in Table 2 facilitate the creation of the growth matrix for the characteristics of maritime passenger transport service with reference to the current and future values for the period 2008-2025.

The vector of growth of the characteristics of service in maritime passenger transport is:

$$\Delta Y'_{2025} = \begin{bmatrix} 30 \\ 60 \\ 35 \\ 65 \\ 60 \\ 20 \end{bmatrix} \quad (10)$$

The vector of the reciprocal values of the characteristics of service in maritime passenger transport is:

$$\frac{1}{Y_{2025}} = \left[\frac{1}{90}, \frac{1}{80}, \frac{1}{85}, \frac{1}{95}, \frac{1}{80}, \frac{1}{90}\right] \quad (11)$$

The product of the external vector $\Delta Y'_{2025}$ and $1/Y_{2025}$ determines the growth matrix for the characteristics of maritime passenger transport service with reference to the current and future values.

The growth matrix of the importance of maritime passenger transport service characteristics as model elements of inter-city passenger traffic route organization was derived from calculation results, with reference to the current and future values for the period 2008 - 2025 (cf. Table 3).

The research conducted and the valuation of the characteristics of maritime passenger transport service as elements of inter-city passenger traffic route organization model have produced direct growth rates of individual characteristics as the model elements (Figure 2).

Figure 2 clearly shows that, in the upcoming period, all the characteristics of services in sea-borne passenger traffic as model elements of inter-city passenger traffic line organization should achieve considerable growth rates, which would allow national shippers to cope with foreign competitors, including those operating in other modes of transport.

Direct growth rates of the characteristics of services in maritime passenger traffic as model elements of inter-city passenger traffic line organization can be divided into two main groups.

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The first group consists of the ability to create sea-borne passenger traffic service and travel duration, both having direct growth rates of 75 %, and the social costs of transport with the growth rate of 68.42 %. The impact of these characteristics as model elements of inter-city passenger traffic line organization can be assessed as markedly strong.

The other group of characteristics includes individual travel costs with the growth rate of 41.18 %, transport safety with the growth rate of 33.33 %, and other elements (25 %). The impact of these characteristics as model elements of inter-city passenger traffic line organization can be assessed as moderately strong.

Indirect growth rates of the characteristics of services in sea-borne passenger traffic as the model elements of inter-city passenger traffic line organization can also be anticipated from results presented in Table 2.

Table 3.
Growth rates of the importance of characteristics over the period 2008-2025.

	Safety	Travel duration	Individual costs	Social costs	Ability to create tr. service	Other elements
Safety	30/90= 0,333333= 33,33 %	30/80= 0,375= 37,50 %	30/85= 0,352941= 37,50 %	30/95= 0,315789= 31,58 %	30/80= 0,375= 37,50 %	30/90= 0,3333= 33,33 %
Travel duration	60/90= 0,666667= 66,67 %	60/80= 0,75= 75,0 %	60/85= 0,7059= 70,59 %	60/95= 0,631579= 63,16 %	60/80= 0,75= 75,0 %	60/80= 0,75= 75,0 %
Individual costs	35/90= 0,388889= 38,89 %	35/80= 0,4375= 43,75 %	35/85= 0,411765= 41,18 %	35/95= 0,368421= 36,84 %	35/80= 0,4375= 43,75 %	35/80= 0,4375= 43,75 %
Social costs	65/90= 0,722222= 72,22 %	65/80= 0,8125= 81,25 %	65/85= 0,764706= 76,47 %	65/95= 0,684211= 68,42 %	65/80= 0,8125= 81,25 %	65/80= 0,8125= 81,25 %
Ability to create traffic service	60/90= 0,666667= 66,67 %	60/80= 0,75= 75,00 %	60/85= 0,705882= 70,59 %	60/95= 0,631579= 63,16 %	60/80= 0,75= 75,0 %	60/80= 0,75= 75,0 %
Other elements	20/90= 0,222222= 22,22 %	20/80= 0,25= 25,0 %	20/85= 0,235294= 23,53 %	20/95= 0, 2105= 21,05 %	20/80= 0,25= 25,0 %	20/80= 0,25= 25,0 %

Further discussion involves the comparison of the characteristics of services in sea-borne passenger traffic that will have markedly high direct growth rates, namely the travel duration and the ability to create sea-borne passenger traffic service, with the characteristics having lower growth rates. Even though individual travel costs are not a characteristic that will have a very high growth rate, they will be compared with other service characteristics because gathered empirical data have confirmed that travelling costs are presently the most important characteristic of the transport service when choosing the mode of transport. Naturally, the comparison of other elements of the model using the same principle is also possible, but it will not be performed due to limited space.

When comparing travel duration with other characteristics of services in sea-borne passenger traffic, the growth rates of travel duration in relation to other service characteristics range from 63.16 % to 75 % (Figure 3).

Travel duration as a service characteristic in sea-borne passenger traffic generates the highest growth rates with respect to its ability to create sea-borne passenger traffic service (75 %) and other elements (75 %), which implies that the growth of importance of these characteristics will result from travel duration.

However, when indirect growth rates of other service characteristics in maritime passenger traffic are compared with travel duration (Figure 4), the highest growth rates are clearly achieved by social costs of transport (81.25 %) and the ability to create sea-borne passenger traffic service (75 %). This means that the importance of these service characteristics most effectively contributes to the growth of importance of travel duration as the service characteristic essential for organising fast sea-borne passenger traffic routes.

When comparing the ability to create sea-borne passenger traffic service with other characteristics of services in sea-borne

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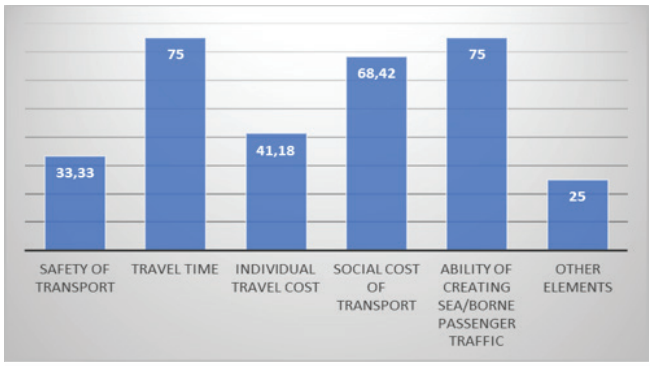

Figure 2.
Direct growth rates of the characteristics.

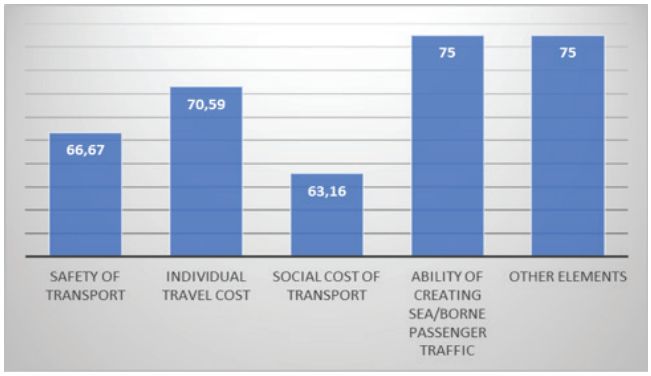

Figure 3.
Growth rates of travel duration in relation to other service characteristics.

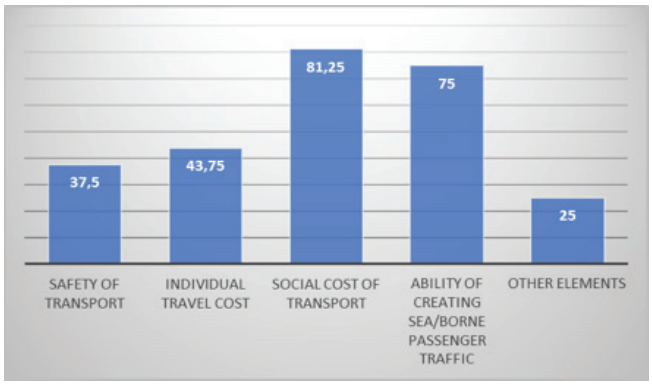

Figure 4.
Indirect growth rates of other service characteristics vs. travel duration.

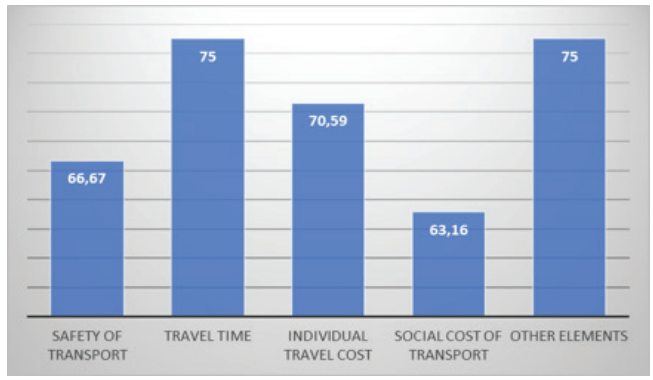

Figure 5.
Indirect growth rates of the ability to create sea-borne passenger traffic service in relation to other service characteristics.

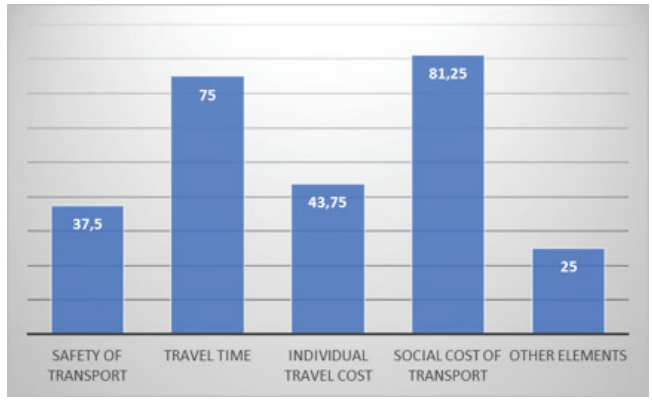

Figure 6.
Indirect growth rates of other service characteristics in comparison with the ability to create sea-borne passenger traffic service.

passenger traffic, growth rates range from 63.16 % to 75 % in comparison with other service characteristics (Figure 5).

The ability to create sea-borne passenger traffic service as a service characteristic in sea-borne passenger traffic has the highest growth rates when compared to travel duration (75 %) and other elements (75 %), which implies that the growth of importance of these characteristics will result from the ability to create sea-borne passenger traffic service.

However, when indirect growth rates of other service characteristics in maritime passenger traffic are compared with travel duration (Figure 4), the highest growth rates are clearly achieved by social costs of transport (81.25 %) and the ability to create sea-borne passenger traffic service (75 %).

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This means that the importance of these service characteristics most effectively contributes to the growth of importance of the ability to create sea-borne passenger traffic service as the service characteristic essential for organising fast sea-borne passenger traffic routes.

When comparing individual travel costs with other characteristics of services in sea-borne passenger traffic as model elements affecting the introduction of inter-city lines, the growth rates of individual travel costs range from 36.84 % to 43.75 %. Their comparison with other service characteristics is provided in Figure 7.

When comparing indirect growth rates of other service characteristics in maritime passenger traffic with individual travel costs (Figure 8), it is obvious that social costs of transport (76.47 %) and the ability to create sea-borne passenger traffic service (70.59 %) have the highest growth rates.

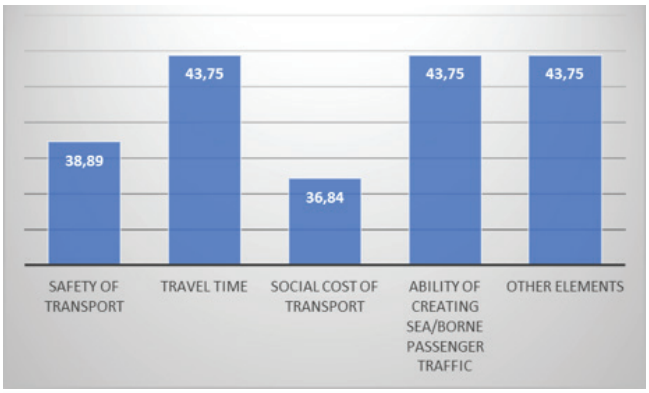

Figure 7.
Indirect growth rates of individual travel costs vs. other service characteristics.

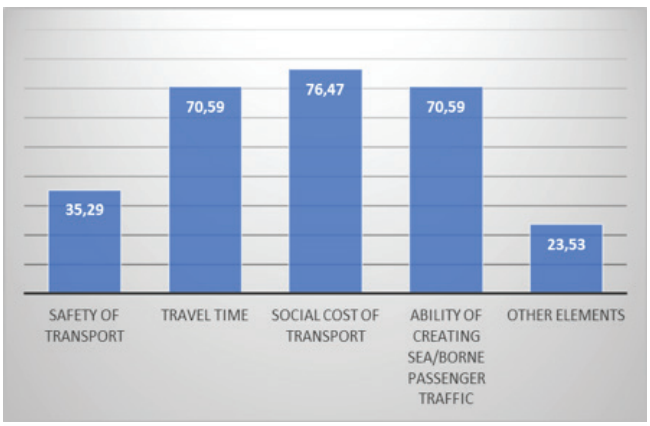

Figure 8.
Indirect growth rates of other service characteristics vs. individual travel costs.

This implies that the importance of these service characteristics most effectively contributes to the growth of importance of individual travel costs as a service characteristic essential for organising fast sea-borne passenger traffic routes.

5. CONCLUSION

The requirements for establishing fast sea-borne inter-city passenger lines in the Republic of Croatia arise from the need to redirect passenger traffic from overburdened road infrastructure to seaways. Maritime transportation offers a number of benefits as it is more environmentally-friendly, more cost-efficient, more reliable and safer than road transport. The introduction of new inter-city passenger lines would reduce overall transport costs since maritime infrastructure (fairways and seaports) already exists. However, this potential cannot be fully exploited without effective entrepreneurial ideas and projects.

The conducted research and valuation of the importance of the characteristics of maritime transport service for the period 2008-2025 have confirmed that all characteristics of sea-borne passenger traffic will produce significant growth rates. This will allow Croatian shippers to cope with foreign competitors and competitors operating in other modes of transport. The direct growth rates of service characteristics in maritime passenger traffic as model elements for the organization of inter-city lines have been divided into two essential groups. The first group consists of the *Ability to create sea-borne passenger traffic service* and *Travel duration*, both having direct growth rates of 75 %, and *Social costs of transport*, with the growth rate of 68.42 %. The impact of these characteristics can be assessed as markedly strong. The other group of characteristics includes *Individual travel costs*, with the growth rate of 41.18 %, *Transport safety*, with the growth rate of 33.33 %, and *Other elements* (25 %). The impact of these characteristics as model elements for the organization of inter-city sea-borne passenger lines was assessed as acceptable, with strong prospects for further enhancement and validation.

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Safety Issues, Security and Risk Management in Nautical Tourism

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The relatively new nautical market gave rise to a special kind of tourism. Nautical tourism as a system has the characteristics of a traffic system with all its peculiarities. Nautical tourism is steadily increasing. In countries nurturing this type of economic activity, nautical tourism has the characteristics of mass tourism. Nautical tourism is a complex system consisting of and using various forms of technical and technological processes. As such it is exposed to various risks. Therefore, this paper proposes a systematic approach to the development of safety measures in nautical tourism.

KEY WORDS
~ Security
~ Safety
~ Risk management
~ Nautical tourism

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1. NAUTICAL TOURISM

Nautical tourism is a special kind of tourism. Nautical tourists navigate through various aquatic environments - seas, rivers and lakes. According to this division, nautical tourism has the special characteristics of nautical tourism on the coast, on rivers and lakes. Tourism at sea is more hazardous than nautical tourism on rivers and lakes. However, nautical tourism on rivers and lakes in Europe and other parts of the world is increasingly gaining importance. Nautical tourism is a process consisting of functional elements equivalent to the processes in other types of transport,

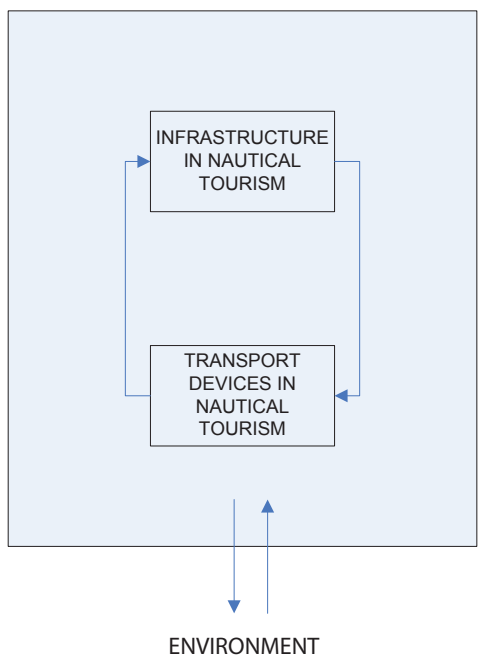

Figure 1.
Systematic model of nautical tourism.

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such as maritime transport or transport along inland waterways, rivers and lakes. Therefore, nautical tourism can be considered a type of transport process with specific characteristics. If seen as a traffic process, it could be systematically defined with a model (Figure 1).

Nautical tourism as a transport system consists of the infrastructure and transport equipment subsystems (EPCI, 2018; Stipanović, Gračan and Bradetić, 2012). Thus, the infrastructure subsystem is a technical-technological land-based system in the function of the nautical market, e.g. various types of marinas with their surroundings. In Italian, the term *marine* means a relatively small arc essential to the acceptance and/or stay of vessels in nautical tourism. According to "*The National Association of Engine and Boat Manufactures Incorporated of America*" - USA, a marina is a facility suitable for vessel anchoring, launching, repair and supply. It also offers showering and catering amenities nearby commercial, communication and transport infrastructure. Marina as a subsystem in the nautical market is used for the receipt and stay of vessels in nautical tourism, including tourists - boaters at sea, rivers and lakes. A marina can either be an independent facility with own infrastructure or a part of a larger port for other purposes.

According to the type of construction and level of equipment, marinas are divided into EU and USA types. USA marinas are recognizable by their relatively low-cost, standardized and quality construction. Infrastructural facilities of such marinas are extremely functional and versatile. USA marinas are characterized by efficient business organization. Their construction differs from that of EU marinas which have a relatively poor internal infrastructure and smaller capacity. In practice, we have the concept of dry dock marinas, i.e. land-based facilities rendering services and / or serving as vessel storages in nautical tourism. Depending on their position (λ and ρ) and the waterway on which they are situated, in different countries marinas can be classified as lake, inland waterway and sea marinas. Thus, for example, lake marinas can be considered relatively calm and safe in terms of weather conditions. Sailing boat area in lake marinas is certainly limited by the size of the lake and possible connections with other waterways, other inland areas or the lack thereof, and the sailing characteristics of vessels in nautical tourism. In rivers, the size of the marina depends on the size of the river. Therefore, the navigation area of vessels in nautical tourism is limited by the river's buoyancy and sailing characteristics of vessels in nautical tourism. Sea marinas are considered to be the most widespread type. Judging by the vessels received, they cater to the largest vessels. Vessel navigation area is limited solely by the characteristics of vessels in nautical tourism. An overview of marina plans, available in various marine navigation publications, clearly shows that some are designed to follow the natural characteristics of the land, while others are freely designed or combine these two approaches. Nautical tourism can also have a substantial environmental impact. Certain processes in the ports of nautical tourism increase the impact of various forms of environmental pollution. So, the environmental impact of nautical tourism can be divided into three stages: construction, use and end of use (Kasum, Vidan and Baljak, 2010). Vessels in nautical tourism have impact on the environment during their stay in ports of nautical tourism and sailing. The subsystem of nautical tourism transport devices includes all technical-technological water and/or sea systems in the function of nautical market (Stipanović, Gračan and Bradetić, 2012). Generally, under the Convention on the Safety of Life at Sea (Safety of Life at Sea, SOLAS), vessels are divided into convention and non-convention vessels (SOLAS, 2009). Convention vessels are vessels bigger than 500 GT, including cruise ships. Non-convention vessels are military and police boats, government ships, warships, fishing vessels and boats of primitive construction, as well as pleasure crafts i.e. vessels in nautical tourism. The transport device subsystem of the nautical market pertains to non-convention vessels i.e. pleasure boats: yachts, sailboats, power boats, rafts and other boats. As for the financial impact of nautical tourism in countries with this type of economic activity, it can be argued that it is relatively more profitable than other forms of tourism. However, as a special form of tourism with transport system characteristics, it requires a special approach, particularly in terms of safety, security and risk management, as seen in the general model (Figure 2).

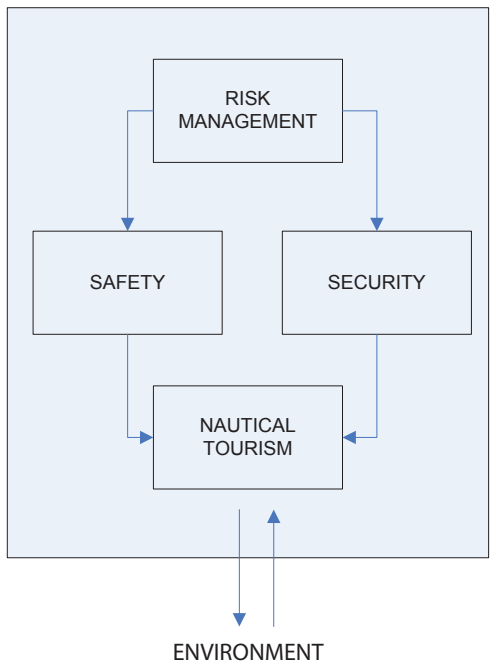

Figure 2.
The general model of safety issues in nautical tourism.

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In conclusion, nautical tourism can be systematically described as an organized entity with infrastructure and transport equipment subsystems designed to meet the special needs of tourists - boaters.

2. SAFETY OF NAVIGATION IN NAUTICAL TOURISM

The safety of navigation in nautical tourism includes all measures of state and other authorities intended to ensure safe navigation (Kasum et al., 2006-A). The measures include legal regulations, the development and use of technical, technological and other resources. In addition to these factors, the safety of navigation also has a direct impact on the accuracy of auxiliary means such as the information content of charts and nautical publications. The safety of navigation depends on the level of knowledge and skills of boaters - tourists in nautical tourism. Their level of knowledge differs depending on the place of education. Therefore, a certain standard of education of persons involved in the operation of the infrastructure and transport means subsystems in nautical tourism should always be maintained. The Republic of Croatia is an example of good practice, with developed nautical tourism activities. Owing to the increasing activity in nautical tourism, marine and yacht technology instructions and maritime management have been implemented into the programs of the Maritime University of Split, Croatia. These programs explore the contents closely associated with the activities of the boating market. They provide students with knowledge and competence, and nautical tourism companies with quality human resources.

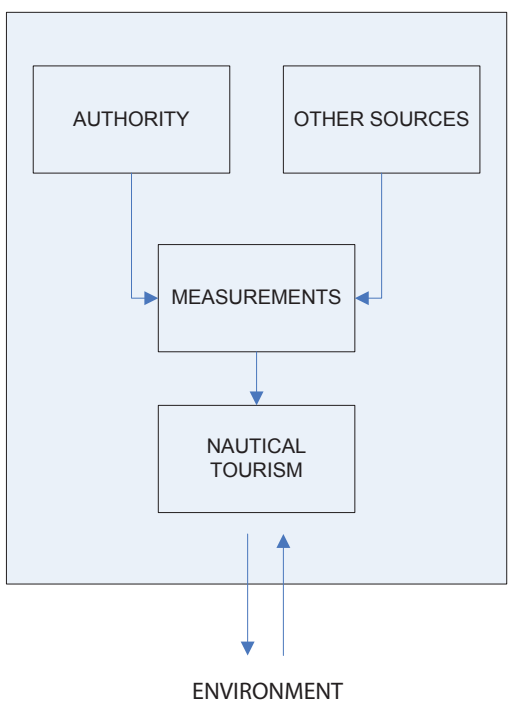

Figure 3.
General model of safety of navigation in nautical tourism.

The significant increase in the safety of navigation in nautical tourism can be concluded to affect the development and implementation of measures in these areas such as legal and other things.

3. SECURITY IN NAUTICAL TOURISM

To protect and ensure the safety of Convention ships navigating the world's seas, rivers and lakes, a system of rules called the ISPS Code (International Standards for Port Safety and Security Code) was developed (ISPS and SOLAS, 2003). Non-convention vessels, including ships and boats in nautical tourism also navigate the world's seas, rivers and lakes and use marinas of nautical tourism. By function and activity, nautical tourism activities are clearly identical to the activities of Convention ships, but are not provided with equivalent security. Croatia can serve as an example of the growing number of vessels in nautical tourism, with the number of vessels in nautical tourism increasing from 160,000 to 250,000 in 2011 (ISPS and SOLAS, 2003) in only five years. Assuming a minimum of four tourists - boaters on each vessel, the Croatian Adriatic coast can be surmised to have been visited by approximately 1,000,000 people in the summer of 2011.

The lack of rules regulating the security of this category of vessels and ports can be concluded to represent a real risk to the safety of vessels in nautical tourism, nautical tourism and people.

4. RISK MANAGEMENT IN NAUTICAL TOURISM

Risk, i.e. predicted or expected damage arising from any variety of hazards, losses, threats, etc. is calculated. Management as a concept can be kept as an organized monitoring method. Nautical tourism is exposed to various forms of danger, losses, threats, human trafficking etc. which can be determined along with the concept of risk in nautical tourism. Therefore, risk management in nautical tourism can be defined as a process aiming to monitor processes in nautical tourism and in the infrastructure and transport equipment subsystems, i.e. on vessels in nautical tourism. Generally speaking, the level of risk is equal to the probability function and the potential risk of adverse events. In nautical tourism, perceived as a specific transport process, risk occurs in the infrastructure and transport means subsystems. A process with measurable parameters can be conducted. Therefore, parameters essential for conducting the risk management process in nautical tourism should be defined (Figure 4).

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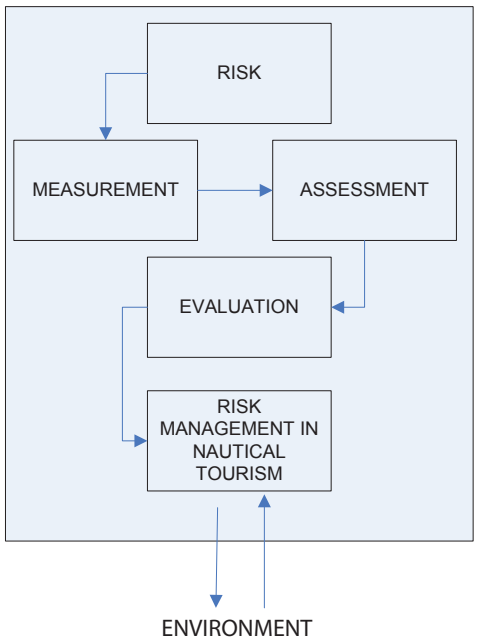

Figure 4.
The model of risk management in nautical tourism.

Table 1.
Elements of risk management in nautical tourism.

SOME ELEMENTS OF RISK IN NAUTICAL TOURISM	REMARK	MEASUREMENT RESULTS
Infrastructure	R_1	MARK
Yacht	R_2	n
Sailboat	R_3	n
Speedboat	R_4	n
Boat	R_5	n
Raft	R_6	n
Other vessels	R_7	n
Security	R_8	MARK
No. of tourists-boaters by M^2	R_9	n
Vessel density by M^2	R_{10}	n
Season	R_{11}	t
Forecast	R_{12}	v
Position	R_{13}	x,y,z
Environmental impact	R_{14}	MARK
Other	R_n	nm

Table 1 is an overview of certain risk elements in nautical tourism which should be properly monitored.

The conclusion is that extant nautical tourism risk management measures, such as: strategic marina management (Kasum, Bozic-Fredotovic and Vidan, 2009), security (Kasum, Vidan and Baljak, 2006), navigation safety (Kasum et al. 2006-B; Kasum, Baljak and Vidan, 2007; Kasum, Gržetić and Marušić, 2007; Kasum, Vidan and Skračić, 2010), the security of the environment in nautical tourism (Kasum, Vidan and Baljak, 2010), e-navigation (IHO, 2018), critical infrastructures (EPCIP, 2018) should be applied and new measures developed (Kasum, Vidan and Baljak, 2006). It is important to sensitize the global community about the problems and potential risks in nautical tourism, develop and implement an appropriate standardized risk management model in nautical tourism on a global level.

5. CONCLUSION

The relatively new nautical market can be considered to be a meeting point of supply and demand of goods and services in nautical tourism. In the framework of the systematic analysis of this transport system type, the infrastructure and transport equipment subsystems have been observed. The infrastructure subsystem of the nautical market includes technical-technological systems, water and/or the sea in the function of the nautical market. The term transport subsystem of the nautical market refers to all technical-technological systems which can be used in navigation in nautical tourism. Nautical tourism is systematically organized as a whole intended to meet the special needs of tourists - boaters. Nautical tourism as a system is exposed to various risks. To improve risk management in nautical tourism, legal and other measures regulating the safety of navigation need to be developed and implemented. To ensure better protection, the development of rules regulating the safety of this category of vessels and ports should be supported.

The harmonized development and implementation of risk management systems in nautical tourism at the international level can reasonably be expected to significantly reduce risk.

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Regulation for Providing Medical First Aid/Medical Care on Board Ferry Vessels in Croatia: Update Proposal

Luka Vukić, Rosanda Mulić, Ivan Peronja, Merica Slišković

The Republic of Croatia is a leader in maritime passenger transport in the Adriatic with indications of the further growth. The paper analyses current regulations for providing medical care on board vessels in Croatia for the category C2 of navigation, referring to vessels in the national coastal navigation. The prescribed quantities of medicinal products and equipment on ferry vessels were compared with the data of most common diseases and injuries of passengers on board, retrieved from the relevant literature. The comparison was conducted based on two indicators: the frequency and urgency of diseases and injuries. The analysis indicated the insufficient quantity of medicines and equipment, especially in the cases of life-threatening medical conditions. The regulations should follow the growing maritime passenger transport, where the large inflow of passengers is expected regularly in the summer period. All the personnel on board appointed for the provision of medical care are required to provide immediate treatment, increase the level of preparedness, and improve the prevention of possible health risks onboard vessels. The authors want to emphasize the importance of passenger safety on board as well as the preservation of strategic resource for the Croatian economy.

KEY WORDS
~ Croatia
~ Ferry vessels
~ Medical care
~ Passenger transport
~ Regulation

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1. INTRODUCTION

Croatia is a maritime country with a long tradition and a hundred of islands connected with shore and major coastal areas by ferries, passenger ships, hydrofoils, and catamarans. This means of transport, especially ferries, are essential for the 124,955 residents on the inhabited Croatian islands. According to the Croatian Bureau of Statistics, 30.9 million of passengers were transported by ferries and passenger ships in 2017 with the tendency of continuous increase. The state-owned company is responsible for the maintenance of a vast majority of shipping lines towards the islands and with the fleet of 50 vessels makes 80% of the total of transported passengers and vehicles in the maritime transport of the country.

With the accession of the Republic of Croatia to the European Union, the Directive 92/29/EEC, regarding the medical treatment on board vessels was transposed in the Croatian national legislation in the form of Ordinance on the minimum requirements and conditions for providing medical care on board vessels, boats, and yachts. The increase of passenger transport in the Croatian ports is not accompanied with the necessary

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modifications of the Ordinance especially in the part that regulates the category of national coastal navigation. It appears that for this category of navigation the Ordinance prescribes currently insufficient medical equipment for provision of medical assistance in serious, life-threatening cases that are, according to total number of passengers, possible and expected on board particularly in summer periods. This is manifested in the absence of the basic equipment or, more precisely, the equipment for resuscitation and transport immobilization. With the existing Ordinance the risk of potential fatal consequences increases as well as the creation of negative public image and distrust of the users as participants in the transportation chain in the event of an accident. Regarding potential injuries, the Ordinance provides only a set of stop bleeding (hemostasis) and wound bandaging. Bearing in mind a number of potential, different medical conditions that could happen to passengers in the current circumstances, the Ordinance should be analyzed. The analysis of maritime passenger transport in Croatia and existing Ordinance aims to improve passenger safety, quality of traffic service, and safety of navigation.

2. ANALYSIS OF THE MARITIME PASSENGER TRANSPORT IN CROATIA

Maritime passenger transport is an important segment of passenger transport on a global scale, and in that form often neglected in the scientific literature (Stupalo et al., 2016). It is divided into cruise and non-cruise modalities, of which the latter refers to passengers transported by ferry vessels. The characteristics of ferries are manifested on relatively short distances and liner services (Holt et al., 2017). The global ferry industry transports yearly around 2.1 billion passengers with additional 250 million vehicles and 32 million trailers (InterFerry, 2018). According to the research carried out by Martino and Brambilla, the Mediterranean is the dominant region in Europe regarding the share of passenger volumes on ferries (Maritino and Brambilla, 2016), as shown by Figure 1.

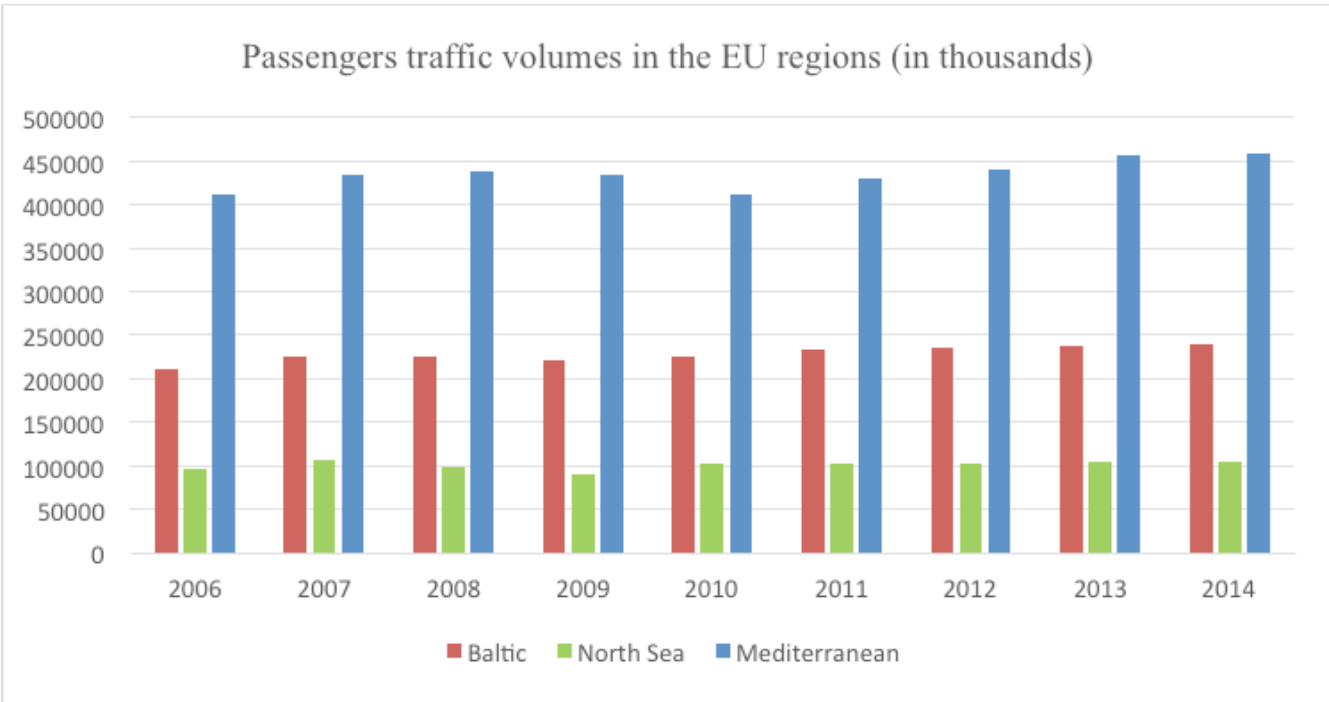

Figure 1.
Passenger traffic volumes on ferry vessels in the EU regions (in thousands) (Maritino and Brambilla, 2016).

The Mediterranean, a leader in the ferry traffic in Europe, recorded a 56 %-share or 464,972,769 of the total of 830 million passengers transported in Europe by ferry ships in 2017 (Holthof, 2017).

The Republic of Croatia surpassed the share of 18 % of GDP from tourism income in 2015 (Croatian Chamber of Economy, 2017). One of the essential segments both for tourism and the development of the inhabited islands is maritime passenger transport, which recorded a total traffic of 32.5 million passengers in the Croatian seaports in 2017. Table 1 shows the national traffic increase of 5.77 % with regard to 2016 (Croatian Bureau of Statistics, 2018)

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Table 1.
Passenger traffic in Croatia, various modes (Croatian Bureau of Statistics, 2018).

Year	Traffic of passengers in total	National traffic of passengers	International traffic of passengers
2013	28,791,287	26,938,838	1,852,449
2014	24,710,914	22,981,095	1,729,819
2015	28,513,365	26,837,904	1,675,461
2016	30,983,336	29,235,931	1,747,405
2017	32,523,201	30,921,981	1,601,220

The importance of ferry transport in Croatia is manifested in the direct economic impact of the Croatian shipping industry and its contribution to the GDP. In 2016, it exceeded 1.2 billion HRK (Croatian Kuna), where ferry transport contributed with more than 30 % of total direct impact and directly employed more than 30 % of employees within the shipping sector in Croatia (Oxford Economics, 2017).

The vast majority of maritime liner transport routes in Croatia are managed by the state-owned company, which surpassed over 11.8 million passengers and 2.9 million vehicles transported in 2017. The company dominated both segments of transport in 2017 leading the market with the share of 87 % of the total passenger transport and 89.8 % of vehicle transport (Costal Liner Service Agency, 2018). The coastal line passenger transport enables permanent and efficient connection of the islands and coast (Ministry of the Sea, 2017), especially important for the inhabitants deeply relying on the ferry (liner) and catamaran service in everyday life.

The study realized by Risposte Tourismo indicates ferry transport as a valuable means of transport regarding the geographical structure of the Adriatic. It also demonstrates the significance of ferry, hydrofoil and fast catamaran traffic for the Croatian ports, marked as the overall leaders in the Adriatic in the segments of passenger movement as well as the number of the port of calls in 2016. Croatian ports retained over 50 % of passenger movement in the Adriatic, almost half of the overall number of passengers, and 57 % of ports of call, maintaining the positive trends over the recent years. The forecasts in the Adriatic and the Croatian ports are positive, so further increase is expected in the future (Risposte Tourismo, 2017).

3. ANALYSIS OF THE CURRENT REGULATIONS REGARDING MEDICAL CARE ON VESSELS IN CROATIA (FERRIES AND PASSENGER SHIPS)

The existing Ordinance on the minimum requirements and conditions for providing medical care on board vessels, boats and yachts is the main document on the national level in Croatia which prescribes minimum requirements onboard vessels, equipment and devices for the provision of adequate medical care both to crew members and passengers and minimum contents of the ship's pharmacy as well as a form and manner of keeping prescribed records (Ministry of the Sea, Transport and Infrastructure, 2008). All maritime officers in the merchant marine, including the crew, operating on passenger ships are required to possess the proper certificates prescribed by the International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW), some of them mandatory, comprising the certificate of Medical First Aid (STCW VI/4-1) (Mulić et al., 2012). The possession of required certificate indicates the confirmation of completed specific education to perform medical health assistance. Furthermore, masters and officers of higher rank and other crew members who are responsible to provide medical care on board ships are required to possess Medical Care Certificate (STCW VI/4-2), depending on the function(s) and level of responsibility on board. These responsibilities are assigned in practice to officers on deck (first or second officer) designated by the master (Goethe, 1984), having a responsibility in assisting the master in case of injury or another emergency in the provision of medical care both to crew members and passengers onboard (Marine Colleges, 2017). Usually, the 2nd officer is responsible for medical care on board, delegated by the master (Westlund et al., 2016). The proper education and preparedness of the crew members in the provision of medical care on board vessels in emergency are essential for the safety of passengers and crew, especially the ones operating on ferries and passenger ships, given the fact that, unlike cruise ships, they are not required to possess a sick bay or ship's hospital if they are engaged for a voyage of fewer than three days (European Economic Community, 1992). All officers are required to refresh the medical courses every 5 years (Jensen et al., 2005).

The Ordinance recognizes four categories of navigation A1 (Unrestricted navigation), B (Long coastal navigation), C1 (Short

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coastal navigation, Coastal navigation along the Adriatic, National navigation) and C2 (National coastal navigation, National inshore navigation, Local navigation), where categories C1 and C2 are implied for the ferry transport between islands and shore. It is evident that ferries and passenger ships operating in the coastal line passenger transport belong to the categories C1 and C2 of navigation, referring to the "National navigation" and "National coastal navigation". As the "National coastal navigation", category C2, is the dominant segment of ferry transport, related to the vessels navigating in the national coastal navigation in the internal waters of the Republic of Croatia and waters accessible from the sea (Ministry of the Sea, Transport and Infrastructure, 2006), only vessels in this category and the minimum requirements and quantities of medicines and medical equipment on vessels will be analyzed. The Directive 92/29/EEC issued by the Council of the European Union in 1992 provides guidelines for each category of navigation and the Member states, determines a detailed list of minimum requirements on the provision of the medical care on ships, divided into ten annexes. Two annexes of the Ordinance are related to prescribing minimum amounts of medicinal products and medical equipment on ships and divided into main categories, followed by subcategories depending on the type of injury and disease, so for each vessel category, the prescribed quantity of medicinal products and medical equipment, as well as the contents of medical supplies are provided. The main categories of the prescribed medicines and medical equipment for each vessel category (A, B, C1, C2) are indicated in Table 2.

Table 2.
Main categories of prescribed medicines and medical equipment on board ship.

MINIMUM AMOUNT OF MEDICINES ON BOARD SHIP (CATEGORIES)	MINIMUM AMOUNT OF MEDICAL EQUIPMENT ON BOARD SHIPS (CATEGORIES)
medicines for the cardiovascular system	resuscitation equipment
gastro-intestinal system	dressing and suturing equipment
analgesics and antispasmodics	instruments
preparations with the effect on the nervous system	examination and monitoring equipment
anti-allergics and anti-anaphylactic	equipment for injection, perfusion, puncture, and catheterization
respiratory system medicines	general medical equipment
anti-infection medicines	immobilization and setting equipment
compounds promoting rehydration, caloric intake, and plasma expansion	equipment for disinfection, disinsectization, and prophylaxis
medicines for external use	first aid handbook

Each category of medicinal products related to potential diseases on board is divided into subcategories containing prescribed quantities. These amounts prescribed by the Ordinance for the navigation category C2 are presented in Table 3.

Table 3.
Prescribed minimum amounts of medicinal products by categories for navigation category C2.

MEDICINAL PRODUCTS (CATEGORIES)	RECOMMENDED QUANTITY (SUBCATEGORIES)
Medicines for the cardiovascular system	Anti-angina preparations (one dose)
Gastro-intestinal system	/
Analgesics and antispasmodics	Analgesics, antipyretic and anti-inflammatory preparations (one dose of paracetamol tablets)
Nervous system medicines	Seasickness remedies (two doses)
Anti-allergics and anti-anaphylactics	/

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Respiratory system medicines	/
Anti-infection medicines	/
Compounds promoting rehydration, caloric intake, and plasma expansion	/
Medicines for external use	Skin medicines • antiseptic solutions (one dose) • antibiotic ointments (one dose) • anti-inflammatory and analgesic ointments (one dose) Burn preparations (one dose) Eye medicines • antibiotic ointments and drops (one dose) • diagnostics (one dose)

In order to ensure appropriate medical treatment at sea, the minimum required medical equipment on board vessels for the navigation category C2 is presented in Table 4.

Table 4.
Prescribed minimum amounts of medical equipment by categories for navigation category C2.

MEDICAL EQUIPMENT (CATEGORIES)	RECOMMENDED QUANTITY (SUBCATEGORIES)
Resuscitation equipment	/
Dressing and suturing equipment	• disposable polyethylene gloves (quantity 1) • elastic bandages (various sizes; quantity 2) • sterile gauze compresses (various sizes; quantity 3) • triangular sling (quantity 2) • cotton wool (quantity 1) • micropore adhesive dressings (quantity 1) • adhesive elastic bandage (various sizes; quantity 3) • mesh (quantity 1) • Elastoplast (quantity 5) • vaseline gauze (quantity 3) • Calico bandage (various sizes; quantity 5)
Instruments	dissecting forceps and hemostatic clamps (quantity 1)
Examination and monitoring equipment	/
Equipment for injection, perfusion, puncture, and catheterization	/
General medical equipment	/
Immobilization and setting equipment	/
Equipment for disinfection, disinsectization, and prophylaxis	/
First aid handbook	/

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4. THE MOST COMMON DISEASES AND INJURIES OF PASSENGERS ON BOARD VESSELS

There is not enough relevant research data either on the global or national scale on the typical passenger injuries and accidents on ferries and passenger vessels without ship's doctors aboard. Only a few authors dealt with the examination of injuries and accidents in ferry and passenger transport, mainly in the segment of tele-medical services onboard vessels. So for the purpose of this research, the analysis of the other segments of maritime passenger transport on the global scale, mainly cruise, will also be used to demonstrate the most common medical conditions based on which the importance of implementation of the adequate equipment and medicines on board ships will be proposed.

The research made by Holt et al. (2017) is the first research paper on medical emergencies and evacuations without doctors on two ferries during a 3-year period. The research findings showed a total of 169 persons, of which 14 crewmembers transferred for medical emergencies ashore mainly for the heart-related symptoms (38.5 %). Some of the other symptoms with the need of a medical assistance were related to stroke (12.4 %), fracture (11.8 %), acute abdomen (9.5 %) and respiratory (7.1 %) related symptoms. The research indicated the patient transfer rate of 4.3 per 100,000 person-days from ferries to shore side medical facilities, and a total evacuation rate of 2.3 per 100,000 person-days. The authors also indicated the intention of navigation officers to examine the possibility of adding paramedics on smaller ferries operating on shorter crossings (Holt et al., 2017). The statistics of tele-medical service can be interconnected with the typical diseases and injuries on board ferries in the observed period. The data indicate the incidence of the need for radio medical (RM) assistance of 5.7 calls per one million passengers on tours at sea (Jensen et al., 2005). Based on the analysis of 156 passengers and 58 crew members, the most common were gastrointestinal, mental and nervous, and circulatory/respiratory system diseases with the share of 47 %. Angina pectoris was a major problem among passengers. Injuries suffered by passengers like fractures and multiple injuries typically happened by falling, slips and external causes. Also, the authors indicated that most passengers were left uninformed regarding the limited medical help on board ferry vessels. The medicine set contents were considered insufficient in some cases of emergencies (Jensen et al., 2005). Westlund et al. (2016) examined the same field in Sweden on the sample of 651 passengers on passenger ships. The most common were general and non-specific symptoms (22.2 %) followed by the symptoms of cardiovascular (16.5 %), gastrointestinal (15.8 %) and musculoskeletal system (13.7 %). The analysis also noted the main accidents of passengers, where the highest frequency was related to skin (77 %) and then followed by musculoskeletal (75 %), neurological (42 %), general and unspecific (16 %), and digestive injuries (6 %). Vallé et al. (2010) examined cardiovascular diseases aboard ships during a two year period in France. They found 179 such cases, 86 patients were aboard passenger vessel, and 74 passengers among them. They indicated cerebrovascular accidents and myocardial infarction as medical, giving the overview of the French legislation regarding the medical supplies and tele-transmission devices on board which since 2007 prescribes the obligation of possession of material enabling tele-cardiology practice, i.e. ECG and defibrillator. They concluded that in the case of cardiovascular disease an effective and prompt response is required regardless of the infrequency of the disease on board ships (Vallé et al., 2010). The analysis of other available literature indicated the slips and trips, food poisoning, illness and psychological distress (Aequitas Legal, 2014) as well as burns, sprains and strains, broken bones, crash injuries, amputations (Maritime Injury Guide, 2018), as the main injuries onboard ferry and passenger ships.

The data of the most common passenger injuries and diseases on cruise vessels can also be used as a general indicator of passenger pathology. Although considered as incomparable with the ones coming from ferries and passenger ships, the frequency of passengers with emergency symptoms and similarity in most common injuries and diseases in this segment of navigation increases the importance of training to face them and the possession of adequate equipment for emergency cases. As for the cruise ships, the presence of the medical doctor on board is mandatory, which is not the case on ferries and passenger ships.

According to the research of Dahl (2010) on the passenger accidents and injuries on board, among the 633 injured on cruise ships during 3 years, the most frequent type of accidents were trips, slips, falls and hits (active and passive) which amounted to more than 75 % of all the accidents. The most frequent type of injuries was related to open wounds, with the share of 83.2 %, and then contusions, sprains, and strains. The authors also indicated the importance of educated and competent medical personnel and equipment to enable treatment of illness or injury on board (Dahl, 2010). Some authors also dealt with the study of rates of illness of passengers and crew in the four year period at a Caribbean cruise port (Marshall et al., 2016). They concluded that the predominant types of illnesses of passengers were related to infectious diseases; mainly gastroenteritis followed by influenza with the common share of 93 %. Research of Schutz et al. (2014) determined the rate and patterns of passenger illness and injuries on expedition cruise vessels to the Antarctic in the six months period. The study resulted in the 530 consultations for active medical complaints. The most common diseases were motion sickness (27 %), infectious processes (23 %), injuries (14 %), and others. Cardiovascular events were also recorded but

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on rare occasions. Regarding the injuries, the vast majority were related to simple contusions, lacerations, and sprains (Schutz et al., 2014).

Cardiovascular problems reported during the two year period aboard cruise vessels off Florida were analyzed by Novaro et al. (2010), where 100 cardiovascular emergencies were recorded. The most common symptom was chest pain (50 %) and acute coronary syndromes (58 %) as the principal diagnosis. The mean age was 66+/-14 years (Novaro et al., 2010).

Peake et al. (1999) noted that 11 % of their patients, passengers on cruise ships, had serious or potentially life-threatening diagnosis, representing 0.4 % of the total of 196,171 passengers.

Table 5.
Most common symptoms, diseases, and injuries of passengers and crew on board by different authors (ferries, passenger ships, cruise ships).

FERRIES AND PASSENGER VESSELS	MOST COMMON SYMPTOMS AND DISEASES	TYPICAL INJURIES
Holt et al., 2017	heart disorders stroke abdominal pain respiratory symptoms pregnancy	fractures
Jensen et al., 2005	gastrointestinal mental and nervous diseases of the circulatory /respiratory systems– angina pectoris	fractures multiple injuries (falling, slips and external causes)
Westlund et al., 2016	general and non-specific symptoms symptoms of the cardiovascular system symptoms of the gastrointestinal tract musculoskeletal system	skin musculoskeletal neurological general unspecific digestive
Valle et al., 2010	examined only cardiovascular diseases	
Various literature (internet sources)	food poisoning psychological distress	slips and trips burns, sprains and strains broken bones crash injuries amputations
CRUISE VESSELS		
Dahl (2010)		open wounds contusions, sprains and strains trips, slips, falls and hits
Novaro et al., 2010	chest pain and acute coronary syndromes	
Schutz et al., 2014	motion sickness infectious processes other (cardiovascular included).	simple contusions lacerations and sprains
Marshall et al., 2016	infectious diseases gastroenteritis influenza	
Peake et al., 1999	acute coronary syndrome 0.4%	

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5. DISCUSSION

The insufficient amounts of medical products and equipment, often justified with the presence of ambulance vehicle alongside ferry or medical professionals among the passengers, indicate only improvisation in the organization of medical care onboard. The criteria for the prescribed minimum amounts of medicines and medical equipment for any category of vessels should be the frequency of injuries and diseases that happen on board and emergencies irrespective of frequency. Comparing the data obtained about frequent injuries and diseases on ferry and cruise vessels with the prescribed medicines and medical equipment mandatory on board for the C2 category, it is evident that the Ordinance is insufficient with regard to both criteria. Growing passenger transport in Croatia with potential more frequent injuries and diseases on board vessels could deepen this gap. The data from tele-medical consultations prescribed by the Directive and designated to one of the centers onshore and personnel (doctors) trained to provide medical advice (European Economic Community, 1992) are an important indicator of the most common illnesses and injuries on board vessels. Taking into consideration the data of the frequency for radio medical (RM) assistance of 5.7 calls per one million passengers (Jensen et al., 2005) as well as the evacuation rate of 2.3 per 100,000 person-days (Holt et al., 2017), and comparing it with the Croatian seaport passenger transport quantity in 2017, that need could be expected and could be several times more frequent. Consequently, the provision of efficient medical care on board becomes a priority. Given the seasonal features of the Croatian tourism, number of passengers, and frequency of emergency calls, a call could be expected every day or every second day. The current Ordinance mostly prescribes medicines and equipment for non-life-threatening conditions. The distances in the national coastal navigation between ports are short and the passengers are appropriately disposed by emergency services on the coast in a short time period, usually within 2 hours. The recommended choice and quantity of medicines on board vessels for non-urgent medical conditions should correspond to the most common diseases on passenger vessels provided in the relevant studies, mainly related to the diseases of the gastrointestinal system, nervous system, and infectious diseases. They are not a real need in national coastal navigation. Cardiovascular diseases were also noted on board, but unlike others they can often be life-threatening. These diseases as well as allergic/anaphylactic reactions represent the priority in the provision of medical care requiring immediate treatment, so the prompt procedure and efficient utilization of medicines and medical equipment are needed to save life and reduce possible complications and consequences of the disease.

The most common injuries onboard passenger vessels are in the form of simple contusions and fractures from slips, hits, falls, and other external sources. The ship is a special environment and unforeseeable situations are expected, especially when a large inflow of passengers occurs, such as the case of the Croatian passenger transport in the summer periods. The current medical equipment consists only of the sets of stop bleeding and wound bandaging. There is a lack of basic equipment for transport immobilization and setting, referring to the most common injuries obtained by the data from previous studies. Sometimes, the accident results in head contusion and injury of the brain. It is a life-threatening condition and, as already mentioned above, there is no prescribed medical set for resuscitation.

Prescription of the equipment for resuscitation and transport immobilization as a standard for C2 vessel category increases the level of medical preparedness for serious cases as well as of passenger safety. The carriage of a portable defibrillator on board passenger vessels is also recommended, especially when the implementation of automated defibrillators (AED) in the crowded public places is supported by the European Union through various programs and projects (Ferretti et al., 2017). Also, some educative projects promoting the importance of defibrillation were launched in Croatia, but did not achieve the desired effect (Croatian Institute of Emergency Medicine, 2018).

Measures to increase health care on vessels in the C2 category should not be based only on the prescription of equipment and medicines necessary for the prevention and assistance in the event of potential health complications on vessels. The recommendations are focused on the establishment of both Helicopter emergency medical service and Emergency fast boat medical service at sea with trained personnel and innovative technologies, drones for the delivery of medicines non-available on the scene of the accident to provide the necessary medical assistance to persons when characteristics of the disease or injury onboard exceed the possibilities of the crew and available equipment. The improvements are required in the segment of coordination between the existing emergency medical services at sea including the services of Search and Rescue and helicopters provided by the Ministry of Defense. Organization of the events in the port area once per year with the aim of raising citizens' awareness and education on the importance of providing basic medical assistance onboard vessels is proposed. Furthermore, personnel licensed to provide medical assistance on board vessels (Certificate of Medical First Aid and Medical Care Certificate) in national coastal navigation, masters and usually the 1st or 2nd deck officers, are recommended to have annual training for the improvement purposes of provision of medical care on board vessels provided by competent institutions. Finally, the Republic of Croatia should establish the

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Strategy for the development of emergency medical assistance in Croatia providing the guidelines and specific goals, and a vision of the development of this sensitive segment.

The ultimate aim is to indicate that the regulations of the Ordinance are not accompanied by an increase in the passenger transport in the Republic of Croatia as well as the need to preserve one of the crucial resources in Croatia, generators of tourism which creates multiple benefit effects. A clear and strong confidence developing within the land connection with islands and quality of transport to them could collapse in case of negative public image and dissatisfaction of transport users in case of potential accidents or death cases. That is why modification of the Ordinance is imposed as an obligation in order to emphasize the importance of human life and prevention of possible health risks on board vessels in the the eastern Adriatic.

6. CONCLUSION

The available evidence from other studies indicates a lack of the currently prescribed quantity of specific medicinal products and equipment considering both frequency and urgency of injuries and diseases as indicators of the need for specific medical care on board ferry vessels. The inclusion of equipment for resuscitation, transport immobilization, and portable defibrillator in an integral part of the C2 vessel navigation standard in Croatia represents a top priority in potentially life-threatening conditions. Studies on morbidity and mortality of passengers onboard ferry vessels in the Adriatic are necessary to make the findings more relevant.

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Concepts of Recognition of Seagoing Service and Certificates to Crew Members of Warships in Accordance with STCW Convention

Ivo Raffanelli[a], Jakša Mišković[a], Ivica Pavić[b]

The paper analyzes the concepts of application of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, with amendments 2010 (STCW Convention), in the segment of recognition of seagoing service and certification for crew members of warships. Although the STCW Convention does not apply directly to warships, the Parties have the right to continue to recognize seagoing service and certificates of the crew members of their warships. There are different concepts of solutions related to this issue. The paper particularly analyzes legal framework under the STCW Convention. Concepts are compared in several NATO member states through a review and analysis of legal solutions and available training programs from these countries. Similarities and differences of the analyzed concepts are identified. Also, a general model of application in the national frameworks is developed. The authors conclude that it is possible to talk about the principle according to which seagoing service and certificates of the crew members of warships acquired during training and service on warships has been recognized with the fulfilment of the appropriate conditions prescribed by the Parties.

KEY WORDS
~ STCW Convention
~ Warships
~ Seagoing service
~ Certification

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1. INTRODUCTION

The STCW Convention is the fundamental convention issued by the International Maritime Organization (IMO) to regulate, among other things, issues relating to training and certification of seafarers on conventional ships (Safety of Life at Sea ships, SOLAS ships). The STCW Convention also recognizes the possibility that each Party may continue to accept naval certificates and sea going service on warships. The purpose of this provision is to enable crew members of warships to exercise the right for recognition of appropriate naval certificates and seagoing service in order to have the possibility to continue the career on merchant ships. Navies educate their officers primarily at naval academies. The education programs are different according to their content and scope. The paper analyzes the education systems of naval officers in the United States of America, United Kingdom, Kingdom of Denmark and Federal Republic of Germany. The similarities and differences of these systems are identified. The paper also analyzes the status of seagoing service of the Croatian Navy officers and the recognition

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of their certification and training. Recognizing the need of crew members of warships, after completing their naval career, to be enabled to continue their career on merchant ships, the Parties have developed mechanisms for the recognition of seagoing service and naval certificates on the basis of the provisions of the STCW Convention. Since each country has its own education system for naval officers, the above mentioned mechanisms differ in each country. These mechanisms have been formalized through agreements between relevant military and civilian governmental authorities responsible for the implementation of the STCW Convention. The paper analyzes the concepts applied in the United Kingdom, United States of America, Kingdom of Denmark, and Federal Republic of Germany. Based on the analysis of the above mentioned training and education systems and concepts, a general model for the recognition of seagoing service and certificates for crew members of warships has been developed and proposed for application in national legislation of the Parties.

2. LEGAL FRAMEWORK

Since a warship is a non-conventional ship (non-SOLAS ship), national legal and to a certain extent international regulations apply to her. The warship is part of the armed forces of the sovereign state and its legal status is particularly determined in the international law (Rudolf, 2012). Legal status, sovereign immunity and exclusions of warships are governed by the United Nations Convention on the Law of the Sea (UNCLOS) (Pavić et al., 2018). This special legal status also applies to the crew members of warships. Taking into considerations the purpose of warships, navies develop their own education systems, training standards and certification of crew members. Accordingly, warships are exempt from the direct application of international legal regime under the STCW Convention. Under the provisions of Article III "The Convention shall apply to – seafarers serving on board seagoing ships entitled to fly the flag of a Party except to those serving on board,

a) Warships, naval auxiliaries or other ships owned or operated by a State and engaged only on governmental non-commercial service. However, each Party shall ensure, by the adoption of appropriate measures not impairing the operations or operational capabilities of such ships owned or operated by it, the persons serving on board such ships meet the requirements of the Convention so far as is reasonable and practicable,

b) fishing vessels,

c) pleasure yachts not engaged in trade, or

d) wooden ships of primitive build (STCW Convention, 2011)."

Thus, the provision of Article III a) allows that Parties shall independently take measures to regulate the application of the Convention on their own warships. This provision constitutes the basic rule enabling regulation of issues related to recognition of sea going service and certificates for crew members of warships. Due to the above mentioned specific legal status of warships, these issues are under the exclusive jurisdiction of flag states. This provision also takes into account that the application of the STCW Convention does not affect operations and operational capabilities of warships.[1] This means that the crew members of warships are entitled to the recognition of a seagoing service and issuance of appropriate certificates, but that such certificates are not necessary for the performance of service on warships.

Furthermore, the STCW Convention in Article B-IX (Guidance regarding equivalents) defines: "Naval certificates may continue to be accepted and certificates of service may continue to be issued to naval officers as equivalents under Article IX, provided that the requirements of the Convention are met" (STCW Convention, 2011). This means that naval certificates had been recognized even before new regulations and amendments of STCW Convention entered into force; thus, the Parties are encouraged to continue to apply this practice.

In Article IX Equivalents, it is stated that: "The Convention shall not prevent an Administration from retaining or adopting other educational and training arrangements, including those involving seagoing service and shipboard organization especially adapted to technical developments and to special types of ships and trades, provided that the level of seagoing service, knowledge and efficiency as regards navigational and technical handling of ship and cargo ensures a degree of safety at sea and has a preventive effect as regards pollution at least equivalent to the requirements of the Convention. Details of such arrangements shall be reported as early as practicable to the Secretary General who shall circulate such particulars to all Parties (STCW Convention, 2011)." This provision enables the possibility of recognizing seagoing service and certificates acquired when exercising duties on different types of ships or different organizations. It is applied to service on warships and other governmental ships, piloting service, safety at sea related duties carried out in the appropriate state's authorities, and in educational institutions for seafarers.

3. EDUCATION AND TRAINING SYSTEMS FOR NAVAL OFFICERS

Education and training systems for naval officers differ from country to country. Those systems are composed of several levels required to perform duties throughout the entire military career. This paper analyzes only the basic level of education and

1. *Other international conventions, such as UNCLOS, SOLAS and MARPOL Convention also contains similar provisions. These provisions are derived from the principle of sovereign immunity of warships.*

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training, which enables the performance of duties on warships. Each country develops its own system tailored to its own needs. Basically, we can talk about two types of education and training systems for naval officers. The first system involves education at naval academies, and consists of a combination of academic education, basic military training and to some extent specialist training. Such a system has been developed in a number of states (BOEI, 2018).[2] The paper particularly analyzed the education system for the US Navy. In the United States naval officers are educated at the United States Naval Academy. The education lasts for four years and consists of several fields such as engineering and weapons, mathematics and science, humanities and social sciences, professional development, leadership, ethics and law (United States Naval Academy Course Catalog, 2018). After graduation, a foundational training is organized with the aim to prepare young officers to perform their first duties on board of the US Navy surface ships. In order to perform these duties, the officers are trained in Surface Warfare Officers School through Basic Division Officer Course. The Course is an eight-week course of instruction[3] designed to provide the fundamental training for new Division Officers to succeed when they first step aboard ship. The course offers instruction in division-level administration, engineering, leadership, damage control, practical instruction in navigation, seamanship and ship handling (Surface Warfare Officers School Command, 2018). The second system foresees the academic education at universities, while basic and specialist trainings are conducted in appropriate naval training centers. In principle, we can talk about two approaches to this system, one developed in the United Kingdom (and Kingdom of Denmark) and the other in the Federal Republic of Germany. In the UK, after completing education, officers' training is carried out at Britannia Royal Naval College (BRNC). This training is composed of pre-initial naval training, basic and professional training. Pre-initial naval training is a 15-week course aimed to provide basic skills deemed necessary to commence Initial Naval Training (PRE-INTO, 2018). Basic training, named Initial Naval Training (Officer), is a 30-week course with the aim to prepare young officers for subsequent phases of the specialist training (INTO, 2018). The Course is split into two phases (militarization and marinization) (Royal Navy: What's the training like, 2018). The above mentioned courses include (among other) seamanship, navigation, boat driving and boat handling topics. The last phase is professional training which is conducted as a combination of time at sea and time in the classroom (Royal Navy: What's the training like, 2018).

In the Kingdom of Denmark, after completing education, officers' training is carried out at the Royal Danish Defense College. The Officer Education contains branch-specific basic officers' training programs. The Officer Education contains three elements – basic military training, academic military modules and service specific courses (vocational training). The Naval Officer Education has three service specific programs: Operations, Engineering, Weapons and Electronics (Royal Danish Defence College, Officer Education, 2018). In the Federal Republic of Germany, basic naval education is carried out at the Naval Academy in Mürwik (Marineschule Mürwik), after which cadets go to study at the University of Bundeswehr in order to acquire academic education. After graduation, students become cadets again and return to the Naval Academy and other naval schools for advanced training (specialization) (Naval Academy Mürwik, 2018). Within naval education, part of the training is carried out on board German Navy sailing ship Gorch Fock, while within the framework of advanced training (depending on specialization) seamanship and officer-of-the-watch training is conducted (Naval Academy Mürwik, 2018). From the analyzed examples it is obvious that education and training of naval officers differ from education and training of merchant navy officers. For this reason, similarities and differences are identified at appropriate governmental level. Officers (and in most cases other crew members of warships) are able to obtain certificates by complying with appropriate conditions based on previously recognized seagoing service on warships.

4. ANALYSIS OF CONCEPTS FOR THE RECOGNITION OF SEAGOING SERVICE AND CERTIFICATES ON WARSHIPS IN THE UNITED KINGDOM, UNITED STATES OF AMERICA, KINGDOM OF DENMARK AND FEDERAL REPUBLIC OF GERMANY

Seagoing service and naval certificates are neither recognized nor approved by the relevant authorities of all the Parties. Therefore, the concepts of four different NATO countries will be analyzed. Relevant examples from the United Kingdom, United States of America, Kingdom of Denmark, and Federal Republic of Germany are taken into consideration. These four states, distinguished NATO members and parties to the conventions related to international maritime transport, fully recognize seagoing service and naval certificates. Since education, training and service on their warships differ from merchant ships, these countries have reached appropriate agreements with their respective authorities and acknowledged all the specificities and differences in terms of service on warships and merchant ships. The agreements have defined the ways and conditions for recognizing certificates and seagoing services to crew members of warships and their alignment with the STCW Convention.

2. *This system has been developed in the United States, Italy, France, Greece, Spain, Romania, etc. (BOEI, 2018).*
3. *There is a lot of criticism for the training of surface warfare officers (SWO) in the US Navy. Some of them are related to computer-based approach to this Course, while other criticisms are related to insufficient level of standardization of training for SWO. See more on this issue at (McGuffie, 2009).*

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The United Kingdom concept

In the United Kingdom, on 7 December, 1999 a Memorandum of Understanding between the Royal Navy (RN) and the Maritime and Coastguard Agency (MCA) was signed (*Memorandum of Understanding between Royal Navy and the Maritime and Coastguard Agency*) (Royal Navy Officers: Merchant Navy Master's Certificate, 2018). Pursuant to the Agreement, the manner of recognizing seagoing service and certificates of naval officers to obtain STCW certificates of competency has been developed. Discussions with the MCA have commenced to develop a similar Memorandum of Understanding for engineer officers and ratings. More widely, the RN continues to seek to align its training with the STCW requirements. The RN Resettlement Service also offers impartial advice on second careers with many strong links with maritime sector organizations and companies (the UK Parlament, Shipping: Written Question – 39966, 2016). The RN and MCA have recognized differences in training between the RN and merchant navy. With this agreement, seagoing service and certificates on warships for the RN officers are recognized. The agreement defines "accelerated route" of equating duties acquired in the RN with similar duties in the merchant navy defined in the STCW Convention. Figure 1 (Royal Navy to Merchant Navy Transfer Flow Diagram, 2018) presents two different ways of advancement and promotion for naval officers in merchant navy, recognizing the differences between commanding officer of warship and other naval officers. Seagoing service for the RN officers is recognized by the MCA, and they are provided accelerated route to the acquisition of award of MCA officer-of-the-watch (OOW) STCW II/1 certificate. When the RN officers acquire this certificate, they have the possibility to continue their careers according to the usual way of advancement for merchant navy officers. The RN commanding officers' seagoing service is particularly recognized by the MCA, and they are provided accelerated route to acquisition of the award of MCA master STCWII/2 certificate (Royal Navy to Merchant Navy Transfer Flow Diagram, 2018). Officers (including commanding officers) are requested to pass familiarization with merchant ships before gaining their OOW certificate in the merchant navy (Royal Navy to Merchant Navy Transfer Flow Diagram, 2018). The RN officers graduate from BRNC. BRNC program is different from the training programs for merchant navy officers. Therefore, it is compulsory for the RN officers to attend courses that they did not attend during the naval career. Typically, the areas in which the RN officers are required to undergo training, beyond that required for the RN service, are cargo work, stability, medical care and shipmaster's business and law. There is no provision for an RN officer to be granted a master's certificate without first holding an STCW OOW certificate followed by a chief mate's certificate. However, an accelerated route has been agreed, recognizing high quality of the RN training and experience (Royal Navy Officers: Merchant Navy Master's Certificate, 2018). The accelerated route means that commanding officers of the RN warships have the possibility to acquire chief mate certificate after six months of seagoing service as OOW and master's certificate after six months of seagoing service as chief mate or twelve months as OOW. The agreement also solved the procedure for recognizing seagoing service to the crew members of the engine department, and the process of recognition of seagoing service for other crew members of warships is also in progress.

The United States concept

In the United States, a detailed mechanism for recognizing seagoing service and certificates for all ranks and duties on warships has been developed. The mechanism has been elaborated in detail in Blueprint to Mariner publication. The US Coast Guard (USCG), in accordance with its competences, coordinates the process of recognizing navy qualifications and duties of crew members, while the National Maritime Center, as part of this organization, evaluates seagoing service and acquired qualifications during the US Navy service and issue the appropriate certificates (Blueprint to Mariner, 2017). As a general rule, for all duties on US Navy ships, appropriate equivalents have been developed in various segments of civilian affairs, not only and not necessary in merchant navy. In this way, all crew members of US Navy ships were enabled to achieving another career after completing their service in the US Navy. The USCG equates all titles of US Navy crew members that can be linked to positions in merchant navy according to the principles of the rank and duties. To acquire these titles, it is prescribed for each duty to have appropriate period of time spent on service on board of US Navy ships and training required under the STCW Convention (Table 1) (Blueprint to Mariner, 2017). Appointments in service of the engine department are recognized in accordance with similar principles as in the deck department from a crew member forming part of a watch in engine room to the officer in charge of an engineering watch in engine room (Table 2) (Blueprint to Mariner, 2017). USCG license eligibility must be assessed, case-by-case, based on the individual's unique training, experience, duty assignments, and in-service opportunities (Blueprint to Mariner, 2017).

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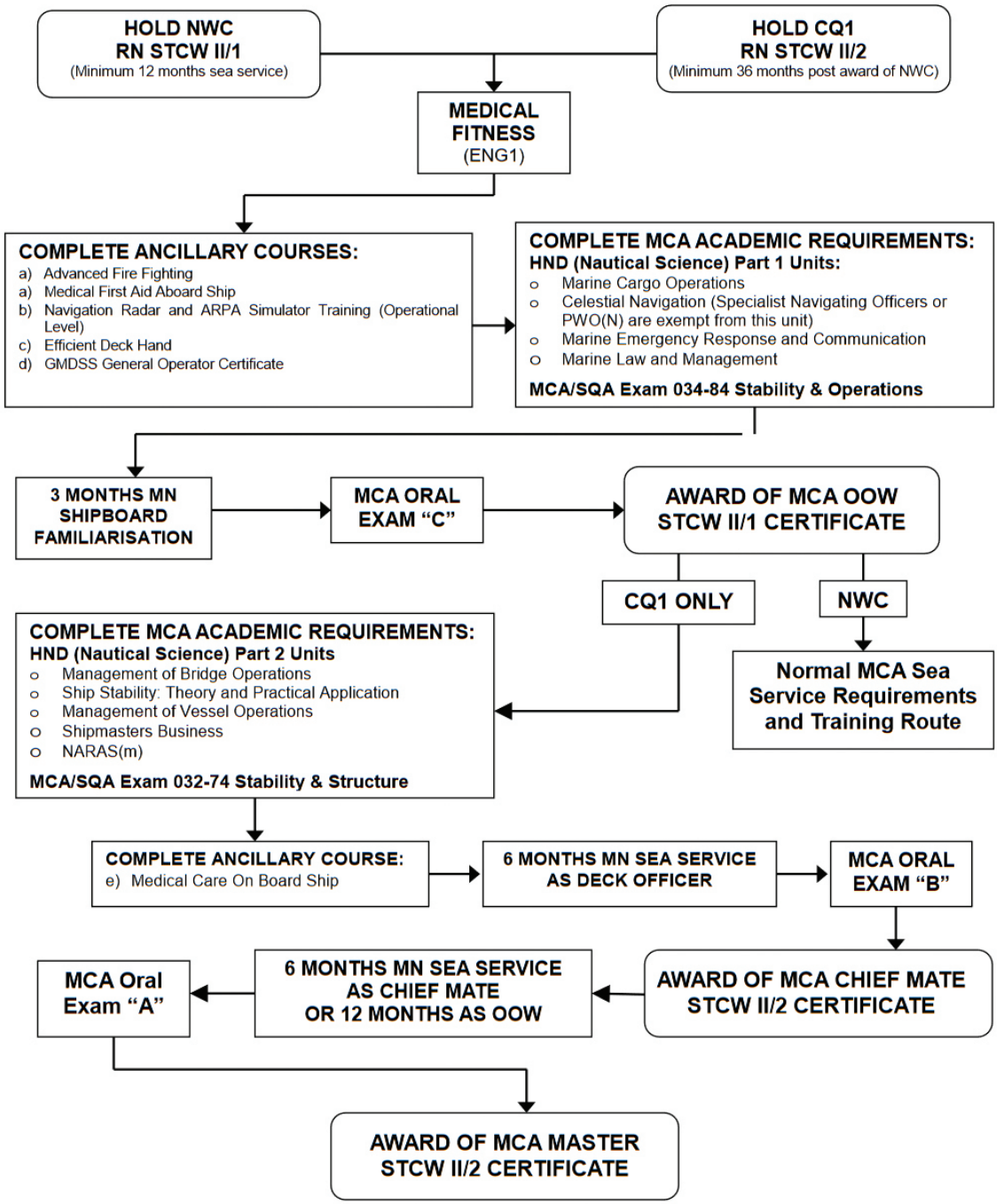

Figure 1.
Royal Navy to Merchant Navy transfer flow diagram (Royal Navy to Merchant Navy Transfer Flow Diagram, 2018).

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Table 1.
Minimum Sea Time for Deck Endorsements (Blueprint to Mariner, 2017).

US Navy Rank	Military rating	Merchant marine equivalent	Sea time required	STCW & other training
E1-E3	SA, SN, BM, QM, GM	Ordinary Seaman, Wiper, Steward (Food Handler)	None	Support Level Basic Training – BT Ratings Forming Part of a Navigational Watch – RFPNW
E4-E6	BM	Able Seaman	1080 days	BT, Lifeboatman, RFPNW
E4-E6	Deck Ratings	AB OSV	180 days on navigable waters of US	BT, Lifeboatman, RFPNW
E4-E6	Deck Ratings	AB MODU	360 days on Vessel over 65 Feet on navigable waters of US	BT, Lifeboatman, RFPNW
E4-E6	Deck Ratings	AB Special	360 days on navigable waters of US	BT, Lifeboatman, RFPNW
E4-E6	Deck Ratings	AB Limited	540 days on vessel over 100 GRT on navigable waters of US	BT, Lifeboatman, RFPNW
E4-E6, E7-E9 & O1-O6, Any USNA Grad wit DWO Letter	Deck Ratings, BMOW, QMOW, DWO, Ops, XO, CO	AB Unlimited	1080 days of Deck Service with 180 days as a Bridge Watchstander and Lifeboatman	BT, Lifeboatman, RFPNW
		3rd Mate – any Gross Tons, near coastal and ocean	1080 days of deck service with 180 days as a Bridge Watchstander and Lifeboatman	BT, Lifeboatman, RFPNW Operational Level NVIC 12-14 – OICNW
		2 nd Mate – any Gross Tons, near coastal and ocean	360 days as 3rd Mate	
		Chief Mate – any Gross Tons, near coastal and ocean	720 days as a 2nd Mate	BT, Lifeboatman, RFPNW Management Level NVIC 10-14 – CM/Master
		Master – any Gross Tons, near coastal and ocean	360 as Chief Mate	

Kingdom of Denmark concept

Pursuant to the Agreement on recognition of maritime training programs concluded between the Danish Navy and the Danish Maritime Authority, seagoing service on Danish Navy ships has been recognized. The aim of this recognition is to issue appropriate certificates of competency for the service on merchant ships. The agreement regulates the way of recognizing qualifications before and after the agreement entry into force (Guidelines on the issue of certificates of competency…, 2018). Prior to the issue of a certificate of qualification it is necessary to provide a certificate of accomplishment of navigation service from the Danish Navy and from merchant ships, exam certificate, training record book as well as a valid health certificate for seafarers. Sea going service on naval ships is proved through a discharge book or a record of service signed by the Navy (Guidelines on the issue of certificates of competency…, 2018). Engineer officers and navigating officers (officer candidates) must forward an approved filled-in training record book or a certified copy of an approval certificate issued by the Admiral Danish Fleet in order to be issued a certificate of competency for the merchant fleet (Guidelines on the issue of certificates of competency…,

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Table 2.
Minimum Sea Time for Engine Endorsements (Blueprint to Mariner, 2017).

US Navy rank	Military Rating	Merchant Marine Equivalent	Sea Time Required	STCW & Other Training
E1-E2		Wiper	None	
E1- E6	A Schools, C Schools	Wiper – Electrician/ Refrigerator Engineer	None	
E1- E6	A Schools	Wiper – Oiler	None	
E1- E6	A Schools	Wiper – Fireman/ Watertender	None	
E1- E6	A Schools	Wiper – Jr. Engineer	None	
E1- E6	A Schools	Wiper – Pumpman/ Machinist	None	
Any		QMED - Qualified Member of an Engineering Department	180 Sea Days with all five wiper ratings – or approved program and 180 days in Engine Room	
Any USNA Grad with EWO Qualification Letter	Any Engine Rating	3rd Assist. Engineer	1080 Sea Days in Engine Department with 720 as QMED or equivalent position per 46 FR 11.516 options	
		2nd Assist. Engineer	2nd Assist. Engineer 360 Days as 3rd Assist. (May qualify for Chief Engineer Limited) 46 CFR 11.514	
		1st Assist. Engineer	360 Days as 2nd Assist. (May qualify for Chief Engineer Limited) 46 CFR 11.514	
		Chief Engineer	360 ys as 1st Assistant.	

2018). On the basis of documentation provided, certificates of competencies for the third and second officer in charge of a navigational watch on ships of 500 GT or more will be issued for Danish Navy officers (for the deck department) and certificates of competencies for officers in charge of an engineering watch in the engine room will be issued for the engine department (Guidelines on the issue of certificates of competency…, 2018). The prerequisite for acquiring OOW certificate is twelve months of seagoing service on board naval ships and merchant ships with 500 GT or above, with the performance of a minimum of:

- six months of actual seagoing service with a training record book from merchant ships with 500 GT or above outside coastal trade or
- three months of actual seagoing service as a supernumerary mate without a training record book from merchant ships with 500 GT or above outside coastal trade (Guidelines on the issue of certificates of competency…, 2018).

For the purpose of achieving certificates of competencies for officers in charge of engineering watch in the engine room, no previous service is required on the merchant navy ships (Guidelines on the issue of certificates of competency…, 2018). Naval officers have no ability to achieve certificates of competency for the management level on the basis of seagoing service from the Danish Navy (Guidelines on the issue of certificates of competency…, 2018).

Federal Republic of Germany concept

In the Federal Republic of Germany, on 25 March, 2003 a Memorandum of Understanding was signed between the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie – BSH) and the German Navy (Bundesmarine). Pursuant to the Agreement, the manner of recognition of qualifications and duties from Bundesmarine ships and crafts with the ones prescribed in the STCW Convention has been defined (Vereinbarung zwischen dem Bundesamt…, 2018). Prior to the issue of a certificate of qualification, it is necessary to provide a certificate of accomplishment of navigation service on Bundesmarine ships and crafts, naval certificates and a valid health certificate for seafarers. Seagoing service on naval ships is proved by a certificate issued by appropriate Bundesmarine department (Vereinbarung zwischen dem Bundesamt…, 2018).

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On the basis of documentation provided, the qualifications are equalized for officers, non-commissioned officers, and sailors in service of the deck and engine departments on Bundesmarine ships and crafts. BSH will issue certificates of competency for the third and second officers in charge of a navigational watch on ships of 500 GT or more, officers in charge of a navigational watch on ships up to 500 GT in coastal navigation, officers in charge of an engineering watch in the engine room with a propulsion power of 750 kW or more, officers in charge of an engineering watch in the engine room with a propulsion power up to 750 kW and certificates of ratings forming part of a navigational watch and of watch in the engine room (Vereinbarung zwischen dem Bundesamt…, 2018). The prerequisites for acquiring OOW certificate are to perform:

- a minimum seagoing service of thirty six months on Bundesmarine ships for officers,
- a minimum seagoing service of sixty months on Bundesmarine ships for non-commissioned officers,
- first degree Bundesmarine certificate, and
- three months of familiarization on a merchant ship with a training record book signed by the master of the ship or by a superior officer (Vereinbarung zwischen dem Bundesamt…, 2018).

Former members of Bundesmarine with an OOW certificate and third-degree Bundesmarine certificate may, after nine months of navigation, exercise the right to gain a certificate of chief mate on a ship of 3,000 GT or more. Officers who have completed second-degree Bundesmarine certificate may, after six months of navigation, exercise the right to obtain the certificate of chief mate on a ship of 3,000 GT or more (Vereinbarung zwischen dem Bundesamt…, 2018). Bundesmarine certificates, training and seagoing services carried out in the engine department on Bundesmarine ships and crafts shall be recognized by BSH. The prerequisites for acquiring certificates for officers in charge of an engineering watch in the engine room with a propulsion power of 750 kW or more and certificates for officers in charge of an engineering watch in the engine room with a propulsion power up to 750 kW are to perform:

- a minimum of seagoing service from twelve to sixty months on Bundesmarine ships depending on the rank and level of education, and
- three months of familiarization on a merchant ship with a training record book signed by the master of the ship or by a superior officer (Vereinbarung zwischen dem Bundesamt…, 2018).

Officers and non-commissioned officers from engine department have been granted recognition of the qualification up to the level of the second engineer (Vereinbarung zwischen dem Bundesamt…, 2018). Sailors in service of the deck and engine departments have ability to acquire certificates of ratings forming part of the navigational watch or forming part of the watch in the engine room if they:

- spent at least six months in service on Bundesmarine ships,
- have adequate civilian training, and
- if their service on Bundesmarine ships can be linked to activities on the deck or in the engine department (Vereinbarung zwischen dem Bundesamt…, 2018).

Crewmembers have no ability to achieve certificates of competency for the master on ships of 3,000 GT or more, and certificates of competency for the management level in the engine department on the basis of seagoing service from the Bundesmarine.

5. OVERVIEW OF CROATIAN NAVY CONCEPT OF EDUCATION, TRAINING, RECOGNITION OF SEAGOING SERVICE AND CERTIFICATES ON WARSHIPS

The concept of education and training for the Croatian Navy officers has changed a few times since its foundation. The concept was fundamentally based on the admission of officer candidates after graduation from the Faculty of Maritime Studies at the undergraduate or graduate level. After selection, candidates completed the basic officers' course. On completion of this course they were posted on their first duties on Croatian Navy ships. Apart from this concept, the concept of education and training of cadets was applied. After selection, the cadets were sent to the Faculty of Maritime Studies in Split for completing their bachelor academic studies. During studying they were provided with the basic military and naval training at camps. After having completed academic education, the cadets attended ten-month basic officer's course before their first assignment to the Croatian Navy ships. This concept was replaced by the development of a new program for cadets' academic education and training developed in cooperation between the Croatian Military Academy "Dr. Franjo Tuđman" and the University of Split. This program will fully standardize the education of future Croatian Navy officers. Analyzing relevant Croatian regulations, it was determined that Regulations for Seafarers' Certification and Certificates do not envisage obtaining the authorization of crew members who have accomplished seagoing service and certain appointments on the Croatian Navy ships (Regulations for Seafarers'…, 2013). The Regulation in Articles 11, 12, and 43 recognizes the seafarers serving on public ships certain rights in the national navigation (Regulations for Seafarers'…, 2013). The Regulations for Boats and Yachts (Article 86.c and 87.c) allow members of the Croatian Navy to acquire a Certificate of Training for the Category B or C boatmaster on the basis of evidence of completion of the basic non-commissioned officer's course or basic officer's course (Regulations for Boats and Yachts, 2005). Crew members of the Croatian Navy ships after completion of service on naval ships

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do not foresee the possibility of recognition of seagoing service, nor the duties they have carried out during their service on naval ships. Current Croatian regulations do not allow recognition of seagoing service or qualifications for crewmembers of the Croatian Navy ships. Therefore, it is proposed to appropriately harmonize the Croatian regulations with the provisions of the STCW Convention in accordance with the examples analyzed in this paper.

6. GENERAL MODEL OF APPLICATION IN NATIONAL FRAMEWORKS

According to the analyses of the education and training systems, agreements between navies and appropriate maritime authorities of particular states, similarities and differences related to recognition of seagoing service and certificates for naval officers in the deck department have been identified and are presented in Table 3.

Table 3.
Requirements for the recognition of seagoing service and certificates for naval officers in deck department.

State	Education system	Training system	Minimum seagoing service on naval ships	Minimum MN shipboard filiarization	Exam equirements	OOW certificate	CO naval certificate recognition
USA	United States Naval Academy	Basic Division officer course	1080 days of deck service	N/A	Yes	OOW STCW II/1	N/A
UK	Academic education at University	Pre-initial naval training, initial naval training	12 months	3 months	Yes (oral exam)	OOW STCW II/1	Yes
Denmark	Academic education at University	Basic military training, academic military modules and vocational training	12 months	3 months as a pernumerary mate	Yes	OOW STCW II/1	N/A
Germany	University of Bundeswehr	Basic naval education, advanced training specialization	36 months	3 months	Yes	OOW STCW II/1	Yes
Croatia	Faculty of Maritime Studies	Basic officer course	N/A	N/A	N/A	N/A	N/A

Although the analysis of the examples in the selected countries has shown that the problem of recognition of seagoing service and the certificates of crew members of warships is solely the responsibility of the flag state, a general model applicable to all the STCW Parties can be proposed. The general requirements are: existence of academic education, naval training with the elements of the STCW Convention requirements, seagoing service on warships, familiarization on merchant navy ships and appropriate exams. Specific requirements are the alignment of education and training with the requirements of the STCW Convention before obtaining the appropriate STCW certificates.

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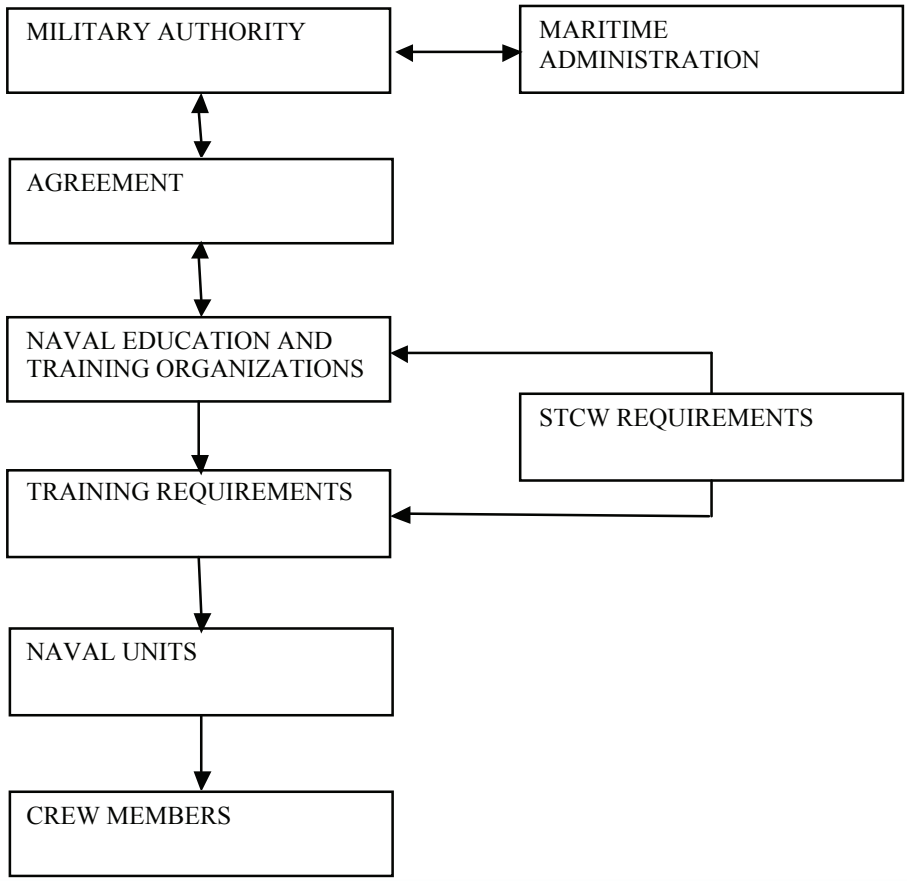

Figure 2.
General model for the recognition of seagoing service and certificates for crew members of warships.

According to the proposed model at the flag state level, it is necessary to sign an appropriate agreement between the military authority and the maritime administration. At this level, the similarities and differences between education and training requirements of the STCW Convention and the naval programs should be identified. The agreement must also define the full methodology and clear criteria for the recognition of seagoing service and certificates for crew members of warships. In order to reduce future differences, the agreement must include mechanisms for monitoring of the implementation and evaluation of education and training requirements of the STCW Convention, without affecting the operational capabilities of warships.

Naval education and training organizations' responsibility is to continuously align naval education and training programs with the STCW Convention to the extent applicable to warships. Training requirements should encompass specific training requirements for naval units and crew members as well as the training requirements from the STCW convention.

According to the proposed model, military authority is responsible to issue certificates of accomplishment of navigation service and naval certificates for all the crew members of warships. The Maritime Authority is responsible to determine differences between the STCW Convention requirements and naval certificates. In accordance with these differences the type and content of the exams for crew members of warships will be developed.

7. CONCLUSION

Naval power of an individual country is not only measured in the number of gray warships but also in the size of its merchant navy. With the end of military career officers, non-commissioned officers, and sailors who served on naval ships should be able to re-qualify with the recognition of adequate qualification and seagoing services achieved on naval ships in order to be able to continue their career on merchant ships. In this way, they will continue to contribute to the naval power of the country.

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In the analyzed examples, the states have applied the provision of Article III of the STCW Convention and have drawn up appropriate rules governing the recognition of qualifications and seagoing services achieved on naval ships. It is noticeable that there is no single mechanism for recognizing these qualifications, and each one of analyzed systems and concepts has its specifics incorporated in national regulations. Officers from all of these navies are admitted to the navy service and enable the acquisition of officer's certificates in the merchant navy. Seagoing service of commanding officers from some of aforementioned navies in that sense have a special status and they are enabled to acquire a higher qualifications in the merchant navy as compared to other naval officers. Officers (including commanding officers) of naval ships, before gaining their first certificate at the merchant navy, have obligation to pass through the familiarization process on merchant ships. Each country recognizes differences in the training of naval officers in relation to merchant navy officers and enables naval officers to achieve prescribed training in a shortened program. All countries take into account the experience, high quality of education and training of naval officers, and enable them to accelerate promotions on merchant navy ships through the above mentioned processes. National regulations take into account all the specificities of education and training, qualifications and duties acquired by crew members of naval ships both in the deck and the engine departments. All the specific situations which are not foreseen in the national regulations are considered separately on a case-by-case basis and are resolved positively by taking into account all the acquired qualifications during service on naval ships. Based on a general model for recognition of seagoing service and certificates for crew members of warships, it is proposed to implement the provisions of Article III of STCW Convention into national regulations and to provide legal prerequisites for recognition of qualifications and seagoing service of crew members of warships. According to the model, it is proposed to draw up the appropriate agreement between relevant government bodies. Pursuant to the agreement, a corresponding regulation should be drawn up, which should take into consideration and regulate all the specificities of recognition of seagoing service and qualifications taking into account relevant naval certificates. This would allow a uniform application of the STCW Convention to a maximum possible extent.

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Issues Affecting Selection and Evaluation of ESP Teaching Materials

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The paper will point out a range of obstacles and challenges English lecturers encounter when teaching English for Specific purposes (ESP) and when deciding which course book and teaching materials would best suit their students in tertiary education. Other issues relating to ESP will also be considered such as what exactly ESP means, main characteristics of ESP courses, their teachers and students. This paper will also include analysis of actions that need to be taken in the evaluation of ESP materials as suggested by various authors on the subject. There will be an example of the specific requirements of teaching materials in Maritime English and their evaluation. The aim is to give an overview of theoretical perspectives and methodologies for the evaluation of teaching materials and to encourage ESP teachers to design evaluation techniques for their type of ESP course.

KEY WORDS

~ ESP teaching materials
~ ESP course book evaluation
~ ESP teachers
~ Tertiary education
~ Maritime English

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1. INTRODUCTION

In this paper the aim is to refer to some obstacles and issues that teachers of English for Specific Purposes (ESP) encounter when teaching ESP and when deciding upon which course book to use with their students in the tertiary institution. While analysing these problems other issues relating to ESP have also been considered, namely what exactly ESP means and what challenges its teachers and learners often have to face. The paper also includes evaluation procedures of ESP course books suggested by many subject matter experts.

ESP is without any doubt a prevailing approach to teaching English as a foreign language in higher education contexts. It is almost completely focused on the particular needs and language requirements of students of specific professional fields. Each ESP has its own characteristics and requirements and therefore, there are many varieties governed by specific needs. This paper offers an example of dealing with the problems of ESP teaching and textbook material evaluation in Maritime English which not only serves to prepare students for their future professions, but also plays a very important role in safety of life at sea.

Many would recommend needs analysis as a prerequisite for either developing a new ESP course or altering the current one. Furthermore, the fact that teaching materials may have a strong impact on students' motivation, teaching methods, vocabulary and language functions which will be taught in the ESP course cannot be ignored (Pranckevičiute & Zajankaauskaite, 2012).

All ESP teachers start teaching ESP (Business English, Medical English, Maritime English, Legal English etc.) with, in most cases, quite scarce knowledge in the subject areas. Therefore, a solid course book is considered a helpful tool in the ESP classes. Riazi (Riazi, 2003 as cited in Baleghizadeh and Rahimi, 2011) claims that course books represent the second most

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important factor in foreign language classes, the first one being the teacher. What is more, course books provide teachers a basic structure for the course, a source of language and a support to learning. Besides, they encourage students' motivation (O'Neill, 1982; Dudley-Evans & St John, 1998 as cited in Baleghizadeh and Rahimi, 2011).

2. CHARACTERISTICS OF ESP COURSES

What distinguishes an ESP course from English for General Purposes (EGP) course is that an EGP course mainly focuses on education while an ESP course focuses on training. In an ESP course, teachers may need methodology different from the one needed for an EGP course and the majority of ESP courses is designed for students who are at the intermediate or advanced levels of English knowledge (Anthony, 1998).

When considering an ESP course, it has to be designed for a specific group of learners who belong to a particular professional context. Hence, the teaching materials need to comply with this group's specific field of study and their future professional communities (Baleghizadeh and Rahimi, 2011; Hyland, 2002). It must be pointed out here that ESP is taught to adults not only at universities or other types of tertiary level institutions, but in-house as well although the needs of learners in these two contexts are to some extent different.

2.1. Advantages of ESP Course Books

ESP course books provide functional and grammatical references suitable for our students (O'Neill, 1982). They offer various ideas for discussions on topics relevant to students' future professions, definitions of complex terms or phrases and they in fact help ESP teachers with the direction their classes will have (Wisniewska, 2012). Beyond any doubt, course books should represent helpful tools for ESP teachers, particularly for the inexperienced ones. Additionally, they offer materials which help students recycle the contents of the units in the course books and in that way improve their learning abilities (Lubina, Kulenović and Lumezi, 2015).

O'Neill (1982) opted for using course books when he had to teach English to a group of German technicians because the course books he used at the time provided well-presented materials that enabled him to adapt his teaching and to improvise when he needed to encourage creative and spontaneous interactions among his learners.

Gatehouse (2001) emphasises that course books need to enable our students to be successful in work-related communication providing them with the ability to use the specialized jargon of a particular professional circle, the ability to employ a set of academic skills appropriate for the occupational setting under discussion and the ability to use the language of everyday informal talk to get engaged in effective communicational activities such as chatting over coffee with a colleague or responding to an informal e-mail message.

ESP course books should help teachers enable and encourage their students to become more independent learners and active participants in the learning process. A good course book contains progress checks which add to the self-study feature that has to be a characteristic of every ESP course book. Furthermore, very important features of ESP course books are authenticity and being up-to-date. An example for the comprehensive as well as teachers and learners-friendly ESP course books is a Market Leader (Cotton, Falvey and Kent, 2010, 2011, 2012) set of Business English course books which are designed based on authentic resources and in cooperation with Financial Times, the prominent journal dedicated to analysis of authentic business issues.

3. HOW TO EVALUATE ESP COURSE BOOKS?

The challenges of selecting an appropriate ESP course book can be rather frustrating sometimes. There are many of them available on the market and all of them published by well-known, well-established publishers (one of them is mentioned in the previous chapter) which may help ESP teachers overcome the problem of selecting an appropriate course book. However, this may be true for the Business English or for the Academic English, but some ESP niche areas suffer from acute course book deprivation mostly for the lack of research and publishers' interest. ESP teachers need a course book that will provide authentic language and contexts but at the same time represent a methodologically well-structured resource that will serve as a solid study material for midterm tests or tests at the end of the ESP course. Moreover, ESP course books have to include authentic situations from the world of work relevant to particular studies and authentic materials relating to those situations which will help ESP teachers involve their students in communicative tasks or other simulations of real work-related situations.

Nunan (Nunan, 1991 as cited in Karimnia and Jafari 2017) emphasised the importance of teaching materials evaluation because it helps teachers select the most appropriate materials which cater for students' interests, needs as well as course programme goals. Furthermore, it is necessary to carefully analyse the contents and methodology of a course book.

Pritchard (2003:9) states that the most usual methods or means of evaluation, found in a number of authors, are the following:

- questionnaires
- checklists
- rating scales
- interviews
- observation

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- discussion
- records
- assessment.

Most of the above mentioned methods are more appropriate for designing teaching materials for an ESP course. Not all of them are applicable for the tertiary teaching context because ESP teachers are the ones who choose the course book which will be prescribed as mandatory literature for an ESP course. In this context in many cases a course book serves as a syllabus, therefore, ESP teachers have to be particularly careful when deciding upon which course book to use with their students.

Hence, there are some useful questions teachers need to answer prior to choosing an appropriate textbook. Shave (2010), for instance, suggests the following questions:

- Will a particular course book provide the syllabus or there is a designed detailed syllabus?
- What are specific goals of the course?
- How long will the course last?
- What kinds of resources will be available in the classroom?
- How many students shall we teach? and
- How will the students' progress be measured?

Ellis (1997) points out that all checklists and guidelines designed for the evaluation of EFL course books are primarily instruments that can help English teachers perform a predictive course book assessment in a systematic way. The instruments, as he claims, are structured in a way which represents the decision-making process English teachers need to go through when carrying out an evaluation of course books.

Furthermore, McDonough and Shaw (McDonough and Shaw, 2003 as cited in Baleghizadeh and Rahimi, 2011:1010) offer three steps of evaluating course books. The first one they entitle external evaluation which includes analysis of the cover, introduction and table of contents. External evaluation provides ESP teachers with "*the intended audience, the proficiency level, the context of use, presentation and organization of materials, and authors' opinion about language and methodology, use of audio-visual materials, vocabulary list and index, cultural aspects, tests and exercises included in the book*." The second step refers to the internal evaluation i.e. assessment of the skills included in the course book, of how authentic listening and speaking materials are, of how appropriate tests and materials are and finding out if the course book can cater for different learning styles. The third step the authors name is the general evaluation of the materials i.e. evaluating "*usability, generalizability, adaptability, and flexibility*" of a particular course book.

Moreover, Shave (2010) designed a list of evaluation criteria used for assessment of course books. These criteria include the following issues:

- aims and approaches,
- language content,
- skills,
- topic and
- methodology.

Aims and approaches refer to the compatibility of course goals and aims of a course book, text adaptability, structure and design, language recycling and the level of user-friendliness. **Language content** requires evaluation of the authenticity of materials, vocabulary, pronunciation, suitable language covered, language styles and language which refers to more complex issues such as social norms. **Skills** would include assessment of suitability of reading, writing, listening and speaking activities. **Topic** is the criterion which emphasises the importance of evaluation of topics included in a course book. Here a teacher should answer questions such as: Are all topics suitable compared to the age, culture and social matters of the students s/he teaches? and Are the topics adaptable and sophisticated enough? The last criterion named is **methodology**. Issues evaluated here are: to what extent is a course book learner-centred; is the language used suitable; are approaches used congruous with your students' abilities; is structure and grammar presented acceptable and is attention drawn to study skills and learner autonomy.

It appears that many teachers of ESP do not carry out empirical evaluations of course books used or the ones they plan to use. Ellis (1997) suggests that there are fewer empirical evaluations carried out than impressionistic ones (when teachers evaluate if a certain activity "works" during the course). One of the main reasons for this, he claims, might be the fact that empirical evaluations are time-consuming. However, he proposes teachers conduct micro-evaluations which are easily manageable and less time-consuming. Micro-evaluations include an evaluation of a single task. In other words, teachers need to assess if aims of the task have been accomplished and if there is a need for improvement of the task (Alderson, 1992 as cited in Ellis, 1997). It might be a good idea, suggests Ellis further, that teachers prepare a report of evaluation procedure because in that way they can have a systematic and explicit description of the whole evaluation process.

4. MARITIME ENGLISH

English has been a lingua franca among seafarers for centuries expanding from the use of basic terminology in English to modern Maritime English that has been standardised by the International Maritime Organisation (IMO) and national legislation of each member state. It is taught at Universities in accordance with the requirements of the 1995 STCW (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers), as amended (IMO, 2011), and Model Course 3.17. The model course for Maritime English presupposes that a very high level of General English (GE) is

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required in order to accomplish specific professional objectives. English for Academic Purposes and Business English are also large areas to be explored just as much as other ESP registers that go beyond general technical vocabulary. Maritime English encompasses the terminology of Ship Construction, Ship Handling, Navigation, Astronomy, Meteorology, Manoeuvring, Maintenance, Safety, Marine-Engineering, Business Economy, Transport, Medicine, Maritime Law, Insurance, not to mention very important role that GE plays in inter-cultural business and social communication on board the ship, and various shore-based companies and institutions.

Although Maritime English has the status of a mandatory, core subject within a specific education and training programme of seafarers, the real requirements go much higher. In his view of the standards and teaching of Maritime English, Pritchard (2002:11) points out that teachers should not only meet the minimum requirements of the IMO Convention but that:

"*They should also carry out a thorough study of the needs analysis while at the same time examining technological, socio-cultural, sociolinguistic, pragmatic and cognitive aspects of the language used at sea*."

According to Pritchard deck and engineer officers need to be competent communicators in English and its specialised subset, Maritime English, in order to meet the shipping industry standards.

4.1. Evaluation of Maritime English Course Books

It was necessary to introduce these special features of Maritime English prior to addressing one of the main questions of this paper - how to select a proper course book and teaching materials for an ESP course. A comprehensive course book for Maritime English that would satisfy all above mentioned requirements is not available on the market and considering the complexity of the subject, we must admit that it would be quite impossible to produce one. The main reasons for limitations of available course books are stated by Pritchard (2003) in his articles "Survey of Maritime English Teaching Materials" and "A Databank of Maritime English resources - An invitation for contributions" (Pritchard, 2004:3):

"*While in the field of English for General Purposes (EGP) there has been a wealth of published materials commercially available on the market, this has not been the case for Maritime English, a restricted subset of English for Specific Purposes (ESP). There seem to be a number of reasons for such a situation:*

- non-existence of standards on Maritime English syllabus,
- *lack of standards on Maritime English textbooks,*
- *unarticulated demand and, in turn, lack of interest on the publishers' side,*
- *poor supply of textbooks for international use,*
- *restrictive national legislations and language policies, and*
- *slow adjustment of conventional textbooks to the developments in foreign language teaching and modern teaching technologies (cf. Pritchard, 2003:3).*"

In his report on the evaluation of Maritime English teaching materials conducted under the auspices of IAMU (The International Association of Maritime Universities), Pritchard (2003) introduces the methods of the evaluation of materials that would later form the methodological basis for a web-based project on evaluation of the Maritime English database materials.

Pritchard (2003) states that there are two criteria for evaluating Maritime English teaching materials: external criteria that refer to extra-linguistic aspects of materials and internal criteria related to language.

We can see from Pritchard's "Survey of Maritime English Teaching Materials" that the most representative materials, available at that time, were analysed taking into consideration some of the most important theoretical views on materials evaluation by prominent scholars such as Sheldon, Robinson, Alderson, Moore, Griffiths, Tucker, Hutchinson and Waters, Shaw, Cunningsworth, Candlin and Breen, Ur, Littlejohn and others. Their questionnaire and checklist suggestions for EGP and ESP were studied and the final proposal for Maritime English textbooks was adapted from Sheldon (Pritchard 2003:81). The proposal includes a checklist that has 46 external factors for evaluation, and a questionnaire containing 26 questions (as in Supplement 1).

Although these and other evaluations of Maritime English teaching materials showed a great quality of presented materials, they also revealed the need for a comprehensive compilation of teaching materials as a databank of Maritime resources that would be made available for use to IMLA (International Maritime Lecturer's Association) and IMEC (International Maritime English Conference), Maritime English teachers and MET institutions worldwide. The goal of fulfilling this need has been achieved and there now is a database containing: "*a digitalised list of textbooks, short course materials, videos, CD ROM and multimedia materials, software and internet resources for the various aspects of Maritime English. The web-based version of the databank also displays PDF format views of title pages, contents and sample units of individual materials*." (Pritchard 2004:1).

In his paper "A Databank of Maritime English Resources - An Invitation for Contributions", Pritchard introduces potential users and contributors to the concept and structure of the Maritime English Resources Database and invites the teachers and learners of Maritime English to offer proposals for improvements, changes, corrections, and modifications of any kind. The teachers are also asked to contribute their own materials and take part in obtaining appropriate materials suitable to specific needs of both Maritime English teachers and learners.

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5. ESP TEACHERS AND THEIR TRAINING

At this point, the demands and challenges ESP teachers and practitioners have to face should be focused on since it is principally they who need to conduct evaluation and selection of ESP course books.

English instructors teaching an ESP course have a very demanding job, particularly at the beginning of their careers when they need to specialise in a field they knew nothing about prior to fulfilling that post. Bell (2002) points out that ESP practitioners have to be receptive to the specific field their ESP course focuses on. Furthermore, there are authors who support the idea that a team of English teachers and field specialists should teach the ESP course. However, some also point out the danger of field specialists monopolizing the contents and structure of an ESP course (Dudley-Evans, 1998).

On the other hand, when in doubt, ESP teachers should not hesitate to ask for suggestions and advice from their colleagues who are specialists in the field students study. These colleagues may offer specific textbooks and other materials that ESP teachers will use to prepare teaching materials for ESP classes (Falaus, 2016). ESP teachers usually acquire all the necessary knowledge from scratch by themselves as they usually come from Departments of English Language and Literature. At first, they are perplexed by the volume of material they do not understand. A similar view is presented by Hutchinson and Waters (1987:161), who argue that teachers trained for teaching General English may "*feel a sense of utter inadequacy at their ability to cope*" with highly specialised ESP materials. All things considered, ESP teachers have to face the situations in which they will become learners themselves (Medrea and Rus, 2012).

ESP teachers should not take a role of, as Robinson states it, "*pseudo teacher(s) of subject matter*" (Robinson, 1991 as cited in Belcher, 2006:140). However, teaching specific skills cannot be fully separated from teaching the subject these skills belong to (Hyland, 2002). We think that teachers should distance themselves from thorough explanations of the content subject matter and refer their students to specialists in those fields. Very often students have more knowledge on the subject being taught, but they need their teacher to assist them in expressing that knowledge.

Nonetheless, there is a lack of comprehensive references on ESP teacher development. There are, however, authors who proposed topics to be included in ESP teacher education, although with one downside and that is that empirical researches were not carried out (Master, 2005; Huttner, Smit and Mehlmauer-Larcher, 2009).

Maritime English teachers, fortunately, have many maritime associations that are at their disposal. For example, The World Maritime University (WMU) in Malmö, Sweden is a postgraduate maritime university founded in 1983 by the International Maritime Organization (IMO), a specialized agency of the United Nations. They organize courses to upgrade the teaching competencies of those professionals involved in the delivery of Maritime English courses with the following learning outcomes:

- have become fully aware of what is required of the contemporary Maritime English teacher to fulfil at least the basic demands of IMO's legal instruments, its advisory Model Course 3.17 and IMO's Standard Marine Communication Phrases (SMCP),
- have an understanding of the current methods being used, and knowledge of the resources available, in order to teach and assess Maritime English competencies,
- be in a position to develop and integrate the competencies discussed into the work situation, and share them with colleagues, and
- be prepared to embark upon a sustained process of self-directed skills development.

ESP teachers need to remain open to continuous learning and keeping ahead of their students when it comes to the acquisition of intricate vocabulary items. This is in order for the teachers to be facilitators and help students in their efforts to become proficient in English both in professional and social settings. They have to be focused on their learners' needs and interests, often having to deal with large classes that are never homogenous when it comes to students' previous knowledge of GE which is essential in order to acquire the desired knowledge and skills. This considerably impacts on the choice of ESP teaching materials.

6. CONCLUSION

Issues analysed in this paper should be of importance to those teaching ESP in tertiary education. The overview and approaches investigated in the paper are supposed to draw attention and raise awareness of ESP teachers and trainers. Unquestionably, teaching ESP includes many demanding tasks for ESP teachers who need to invest a lot of time and effort in their education and professional growth. Learning how to evaluate ESP course books and materials is included in a wide range of those tasks. The authors of this paper have examined many articles discussing the issues regarding ESP teaching and evaluation of ESP course books and teaching materials, in order to help other ESP teachers interested in systematic and structured evaluation by means of checklists and questionnaires as well as some other methods.

ESP course books need to provide support in teaching and managing an ESP course. However, it appears that there are no ideal ESP course books and that ESP teachers may have to be prepared to design or look for supplement materials. On the other hand, evaluation techniques enable teachers to be creative and not to accept second-best, which may lower the efficiency of the ESP course thereby diminishing their efforts. Finally, it is

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understood that students need to be involved in the process of creating a base of material resources and most of the colleagues who are specialists in the subject area could contribute greatly with their expert pieces of advice.

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SUPPLEMENT

CHECKLIST – EXTERNAL AND INTERNAL EVALUATION CRITERIA
Rating scale: 1 to 6 (where applicable)

	External Criteria:	**Yes/No, Scalar Rating, Description, Comment**
1.	AUTHOR(S):	
2.	TITLE:	
3.	PUBLISHER: YEAR:	
4.	ISBN: (total pages:)	
5.	TYPE (textbook, video, CD, software, supporting/back-up material)	
6.	COMPONENTS: SB/TB/WB/cassette/ video/CD/free tests:	
7.	LENGTH (units x hours):	
8.	TARGET LEARNERS:	
9.	TARGET SKILLS:	
10.	TARGET TEACHERS:	
11.	PURPOSE/RATIONALE (designed for the students of/ trainees in …)	
12.	AVAILABILITY (e.g. readily available)	
13.	LEVEL + USER DEFINITION (beginners, lower-intermediate, intermediate, upper-intermediate, advanced)	
14.	LAYOUT/GRAPHICS (clear, attractive print, ...)	
15.	ACCESSIBILITY / ORGANISATION (arrangement of sections, parts, reading text, exercises, ...)	
16.	PHYSICAL CHARACTERISTICS (e.g. space to write notes, fill out exercises) (1-6)	
17.	SUPPLEMENT ARY MATERIALS (vocabulary, tables, additional reading, video, etc.)	
18.	CULTURAL BIAS (1-6) (meeting the requirements of multi- national/cultural/lingual crews/students; yes/no)	
19.	REFERENCE TO OTHER MATERIALS (maritime reference books, conventions, regulations, subject textbooks, ...)	
20.	GENERAL ASSESSMENT OF THE MATERIAL (in case of commercial materials) (rating: 1-6)	
	OVERALL VALUE FOR MONEY (rating: 1 - 6)	
	DEGREE OF APPROPRIATNESS FOR A SPECIFIC COURSE (descriptive assessment: very high - high - medium - low)	
	Internal Criteria:	
21.	PURPOSE / OBJECTIVES - explained in introduction	
22.	APPROACH (acceptable to course curriculum, maritime authorities, maritime industry)	
23.	TYPE OF MARITIME ENGLISH (Comprehensive/General Maritime English, register-oriented, genre-oriented, spoken communication, ...)	
24.	THE NATURE OF LEARNING (content-based, skill-based, task-based, competence-based, ...)	

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25.	CONTENT PRESENTATION (systematic coverage of syllabus; topics covered)
26.	ORGANISATION - layout (content clearly organized into units)
27.	SEQUENCED GRADING OF CONTENT THEMES AND TOPICS
28.	AUTHENTICITY (plenty of authentic language; modified texts)
29.	COVERAGE OF SUBJECT CONTENTS (IN THE CURRICULUM)
30.	GUIDANCE TO LEARNER (in introduction, units)
31.	INTERESTING & VARIED TOPICS & TASKS (to provide for different learner levels, styles) (1 - 6)
32.	DEVELOPMENT OF COMMUNICATIVE COMPETENCE: (1 - 6) fluency in communicative functions: requests, asking questions, permission; possibility; probability; compulsion, obligation, prohibition, denial, negation)
33.	SMCP-BASED TEXT & EXERCISES (totally, partly, none)
34.	PRONUNCIATION
35.	THE FOUR SKILLS (LISTENING, READING, SPEAKING, WRITING) (Description of the methods, tasks, activities, and degree of communicative competence for each skill separately)
36.	VOCABULARY DEVELOPMENT (1 - 6) (explanation and practice): terminology, multi-word lexical units, EGP lexical items in specialized use
37.	GRAMMAR (explanation and practice): (1 - 6) modals, tenses, passive; nominalizations, prepositional/adverbial phrases, syntax of complex sentences)
38.	DISCOURSE ELEMENTS - TEXTUALITY (1 - 6) (discourse markers, coherence, cohesion)
39.	EXERCISES (1 – 6) (relevant, to-the-point, practicing)
40.	SEQUENCED GRADING OF EXERCISES (1 - 6)
41.	CLEAR INSTRUCTIONS for exercises (1 - 6)
42.	KEY TO EXERCISES
43.	SUPPLEMENTARY (VISUAL/AUDIO) MATERIALS AVAILABLE (audio cassette, video, CD, multi-media, software , etc.)
44.	STUDENTS CAN DEVELOP OWN LEARNING STRATEGIES - INDEPENDENT LEARNING (1-6)
45.	GUIDANCE TO TEACHER (adequate, not to heavy preparation load)
46.	ASESSMENT (1 - 6) (in exercises, revision/review, final test)
	ASSESSMENT (descriptive evaluation)

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QUESTIONNAIRE

1. Does the material match learner objectives? Is the purpose clearly defined?

Objectives explicitly laid out in an introduction, and implemented in the material

2. Is the material learner-centred? learners, learning styles, interests, etc.

3. Does the material facilitate interactive learning?

4. develops communicative skills

5. follows rules of content-based learning

6. follows cognitive procedures of the subject-matter (e.g. scripts and scenarios in ship handling, contingency planning; starting or reversing the main engine, etc.)

7. Is the material socio-culturally appropriate?

8. Is the material gender-sensitive?

9. How ethnocentric is the material?

10. CONTENT systematic coverage of syllabus. content clearly organized and graded (by difficulty)

11. Is the material up-to-date?

12. plenty of authentic language

13. Are instructions to students clear? clear instructions

14. Are vocabulary and comprehensible input levels well-graded?

15. Is the material age-appropriate?

16. Is the material interesting and visually attractive? Is it interesting? Is it challenging? varied topics and tasks so as to provide for different

17. Is the material easy to use? Is the ratio of language given/ student task economic?

18. Does it contain distracting difficulties?

19. Is the material relevant to real life?

20. appropriate visual materials available

21. Does the exercise type effectively and economically accomplish purpose? periodic review and test sections

22. good pronunciation, vocabulary and grammar explanation and practice

23. fluency practice in all four skills

24. encourages learners to develop own learning strategies and to become independent in their learning

25. adequate guidance for the teacher

26. Does the material provide assessment: revision/reviews/ final?

(Adapted from Sheldon 1988:242 as cited in Pritchard, 2009)

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CONTRIBUTION

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„Latinsko Idro“ ('Latin Sail') Month on the Island of Murter

On the island of Murter, each year September is reserved for the admirers of traditional shipbuilding and methods of navigation. Gajeta, leut, kaić, lantina, sail, oar... on several occasions the cove on the Island of Murter was packed with larger and smaller fishing boats. Everything started on the Feast of the Nativity of the Holy Virgin, 8th September, with rowing regattas of the crews from Murter, Betina, Jezera, and Tisno. All these are towns on the Island of Murter cultivating the tradition of shipbuilding and navigation. It is interesting to observe that at the regattas men, women, and children competed together. It was all focused upon the wooden boat and the traditional way of rowing. Several workshops including primary school pupils ensued, aimed at raising the awareness of preserving the tradition and the spirit of the place. They were taught in rowing, sailing, managing and maintaining the boat, as well as specific local and dialectal terms. Apart from the events held at seaside and the open sea, lectures, exhibitions, and concerts, dealing with topics concerning drystone, ship, navigation, and a long gone, arduous life of agricultural workers. Matica hrvatska has published a specific issue of Murterski godišnjak ('Murter Almanac'), dedicated to the methods of sailing using latinsko idro ('Latin sail'). The crowning event was the 21st regatta entitled

Latinsko idro, having involved sixty boats from all over the Croatian Adriatic coast. The regatta took place on September the 30th, and, due to a beautiful weather, attracted a large number of admirers of the sea.

The Island of Murter, together with the towns of Murter, Betina, Tisno, and Jezera, has been striving to preserve wooden shipbuilding craft and the seafarer's mentality of its ancestors. Schools of shipbuilding, sailing, and rowing have been held, the Museum of Wooden Shipbuilding Craft was constructed. It is for this reason that it can undoubtedly be said that the Island of Murter is the central place of wooden shipbuilding craft on the Adriatic, thus setting an example how to preserve the tradition and live with it.

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Dual-Frequency GNSS Smartphone Hits the Market

Mobile brand Xiaomi has launched a dual-frequency GNSS smartphone. Fitted with a Broadcom BCM47755 chip, the Xiaomi Mi 8 provides up to decimeter-level accuracy for location-based services and vehicle navigation. The Mi 8 smartphone represents a breakthrough in GNSS technology as the first commercial deployment of Broadcom's dual-frequency BCM47755 chip, designed for the mass market and introduced in September 2017. Until now, mobile location-based applications have been powered by single-frequency GNSS receivers, whose location accuracy is limited to a few meters. However, in recent years GNSS systems have been launching satellites broadcasting signals on new frequencies to open up new possibilities. Specifically, Galileo has the majority of satellites with E1/L1 and E5/L5 frequency capabilities. The E1/L1 + E5/L5 GNSS chip can compute location with an accuracy of up to a few decimeters.

According to the company, users of the Xiaomi Mi 8 and future models with dual-frequency GNSS will benefit from better positioning and navigation experience in urban environments. This is due to the unique shape of the E5/L5 frequency, which makes it easier to distinguish real signals from the ones reflected by buildings, reducing the multipath effect, a major source of navigation error in cities and other challenging environments.

The numerous Galileo satellites broadcasting E5 make this improvement available to users all over the world. In addition, the simultaneous use of two frequencies reduces other sources of error, such as those due to the ionosphere, and the frequency diversity is more resistant to interference and jamming.

In addition to making the existing applications more accurate, the enhanced position precision offered by dual-frequency GNSS will also create opportunities for new applications in areas such as augmented reality, vehicle navigation, and mapping.

Details from: GPSWorld:
http://gpsworld.com/dual-frequency-gnss-smartphone-hits-the-market/ and
https://www.androidauthority.com/dual-frequency-gps-878169/,
https://www.gsmarena.com/xiaomi_mi_8-9065.php.

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KAD FALKUŠA PRIKO SNA ZAJIDRI

Jakša Fiamengo

Još u valu svetega Mikule
kroz ogonj u fjabu gre gajeta
kal se naši upru u pajule
ku pri voga vonka parapeta.

Kal falkuša priko sna zajidri
sve se vroti s facendun kraj skol,
salpa mrižu, pok ca Bog providi,
komu ništa, komu i kvintol.

Još kumpanji kulfon i na kraju
o sardeli provju kal se skupe,
i Komižu u sarce surgaju
kal zavargnu u dinore, kupe.

Kal falkuša priko sna zajidri
Palagruže žolo kal ćapo
sve pasonu udijac se vidi
kal u sarcu lipo zalampo.

WHEN FALKUŠA[1] SAILS ACROSS A DREAM

trans. by Mirna Čudić Žgela

When in the Bay of St. Nicholas
gajeta passes through the flames[2] as if in a fairy-tale
when our men strive and compete
heading hurriedly towards the open sea.

When falkuša sails across a dream,
all things past come back as if in a yarn of yore
throw your fishing nets and trust in God's Providence,
some will catch nothing, and some tons of fish.

Both out at sea and on shore
friends talk of pilchards
embracing Komiža in their hearts
when they sit down to a game of briškula[3].

When falkuša sails across a dream,
and reaches the pebbled shore of Palagruža,
all the days long gone suddenly,
as if in a lightning, flash in the heart.

1. *a type of gajeta, a traditional fishing ship of the Adriatic*
2. *stake, here allusion to a centuries-long tradition of ritual burning of fishing boats on the Eve of St. Nicholas, the patron saint of seamen and fishermen, as well as of Komiža*
3. *Italian card game traditionally played in Dalmatia*

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RJEČNIK

vala	uvala
sveti Mikula	sveti Nikola
ogonj	oganj, vatra, ovdje aluzija na stoljetnu tradiciju ritualnog paljenja ribarskih brodova uoči blagdana svetoga Nikole, zaštitnika pomoraca i ribara i mjesta Komiže
fjaba	priča, pripovijest, bajka
gajeta	tradicionalni ribarski brod na Jadranu
kal	kad, kada
pajul	drvene daske na dnu broda
ku pri	tko prije
voga	zaveslaj
vonka parapeta	izvan zida lukobrana
falkuša	komiška gajeta, tradicionalni ribarski brod na Jadranu
vrotit' se	vratiti se
facenda	zgoda
skol	stube, skale
salpa mrižu	baci mrežu
pok	pa, potom
ca	što
kvintol	kvintal, 100 kilograma
kumpanji	drugovi, prijatelji, ribarska družina
kulaf	pučina
na kraju	na kopnu
sardela	srdela
provjat'	pripovijedati
sarce	srce
surgat'	baciti
zavargnut'	započeti
dinore, kupe	dinari, kupe, boje u briškuli, talijanskoj kartaškoj igri
žolo	žalo
ćapat'	uhvatiti, doseći, doći do
sve pasonu	sve prošlo, čitava prošlost
udijac	odmah
zalampat'	bljesnuti

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About ToMS: Ethics, Conflict of Interest, License and Guides for Authors

The Journal is published in English as an open access journal, and as a classic paper journal (limited edition).

ToMS aims at presenting the best maritime research primarily, but not exclusively, from Southeast Europe, particularly the Mediterranean area. Papers will be double-blind reviewed by 3 reviewers. With the intention of providing an international perspective at least one of the reviewers will be from abroad. ToMS also promotes scientific collaboration with students and has a section entitled Students' ToMS. These articles also undergo strict peer reviews. Furthermore, the Journal publishes short reviews on significant papers, books and workshops in the fields of maritime science.

Our interest lies in general fields of maritime science (transport, engineering, maritime law, maritime economy) and the psychosocial and legal aspects of long-term work aboard.

1. PUBLICATION ETHICS

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Plagiarism is arguably the most complicated ethical issue. Our policies define plagiarism as "taking material from another's work and submitting it as one's own." ToMS *holds authors — not the Publisher or its editors and reviewers — responsible* for ensuring that all the ideas and findings included in a manuscript are attributed to the proper source. We also refer to our role as steward of what constitutes ethical conduct. Ethical misconduct is the reason for our commitment to continue to strive to educate all the parties in the publishing process how to handle this matter. As a member of Crossref, ToMS has a powerful weapon – iThenticate system, which is not perfect.

"Even if there were reliable and sensitive plagiarism detection software, many issues would remain to be addressed.

For example, how much copying is legitimate? Clearly, the reuse of large amounts of others' text constitutes plagiarism. But what should one think about copying short passages from the author's own earlier work, such as commonly occurs in the Methods section? In the Nature article it is suggested that some journals set a quantitative limit whereby the amount of text that can be reused is limited to about 30 percent. This may be utilitarian, but it seems curious and arbitrary that 25 percent of copied text might be deemed acceptable whereas 30 percent might not. Indeed, two authors who copied the same number of words could find themselves on opposite sides of that border if one author simply was more verbose and thus diluted their plagiarized content below the threshold! No, this is not a simple issue at all." [cited from: http://newsletter.aspb.org/ethics.cfm]

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- Properly cite the work of others as well as their own related work.
- Submit only original work to the journal.
- Determine whether the disclosure of content requires the prior consent of other parties and, if so, obtain that consent prior to submission.
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The Journal is published in English as an open access journal, and as a classic paper journal (limited edition).

ToMS aims at presenting the best maritime research primarily, but not exclusively, from Southeast Europe, particularly the Mediterranean area. Papers will be double-blind reviewed by 3 reviewers. With the intention of providing an international perspective at least one of the reviewers will be from abroad. ToMS also promotes scientific collaboration with students and has a section entitled Students'ToMS. These articles also undergo strict peer reviews. Furthermore, the Journal publishes short reviews on significant papers, books and workshops in the fields of maritime science.

Our interest lies in general fields of maritime science (transport, engineering, maritime law, maritime economy) and the psychosocial and legal aspects of long-term work aboard.

6.1. Before you Begin

6.1.1. Ethics in publishing

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You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement then this should be stated.

6.1.7. Open access

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6.2. Guidelines for Authors: Manuscript Preparation and Submission

6.2.1. Organization of the manuscript

First (title) page

The first page should carry:

a. the paper title;
b. full names (first name, middle – name initials, if applicable), and last names of all authors;
c. names of the department(s) and institution(s) to which the work should be attributed. If authors belong to several different institutions, superscript digits should be used to relate the authors' names to respective institutions. Identical number(s) in superscripts should follow the authors names and precede the institution names;
d. the name, mailing address and e-mail of the corresponding authors;
e. source(s) of research support in the form of financial support, grants, equipment or all of these.

Last page

The last page should carry:

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a. ethical approval, if required;

b. authors' declarations on their contributions to the work described in the manuscript, their potential competing interests, and any other disclosures. Authors should disclose any commercial affiliations as well as consultancies, stock or equity interests, which could be considered a conflict of interest. The details of such disclosures will be kept confidential but ToMS urges the authors to make general statements in the Acknowledgement section of the manuscript.

c. a list of abbreviations used in the paper (if necessary);

Other pages

Each manuscript should follow this sequence:

- title page;
- abstract;
- text (Introduction, Methods, Results, Conclusions/ Discussion);
- acknowledgments;
- references;
- tables (each table complete with title and footnotes on a separate page);
- figures and figure legends, and the last page.

6.2.2. Text organization and style

6.2.2.1. Abstract

The second page should contain the Abstract. ToMS requires that the authors prepare a structured abstract of not more than 250 words. The abstract should include (at least) four sections: Aims, Methods, Results, and Conclusion, not necessarily separated.

Aim. State explicitly and specifically the purpose of the study.

Methods. Concisely and systematically list the basic procedures, selection of study participants or laboratory/ experimental/simulation setup, methods of observation (if applicable) and analysis.

Results. List your primary results without any introduction. Only essential statistical significances should be added in brackets. Draw no conclusions as yet: they belong in to the next section.

Conclusion. List your conclusions in a short, clear and simple manner. State only those conclusions that stem directly from the results shown in the paper. Rather than summarizing the data, conclude from them.

6.2.2.2. Main text

Do not use any styles or automatic formatting. All superscripts or subscripts, symbols and math relations should be written in MathType or Equation editor.

Introduction

The author should briefly introduce the problem, particularly emphasizing the level of knowledge about the problem at the beginning of the investigation. Continue logically, and end with a short description of the aim of the study, the hypothesis and specific protocol objectives. Finish the section stating in one sentence the main result of the study.

Results

Key rules for writing the Results section are:

a. the text should be understandable without referring to the respective tables and figures, and vice versa;

b. however, the text should not simply repeat the data contained in the tables and figures; and

c. the text and data in tables and figures should be related to the statements in the text by means of reference marks.

Thus, it is best to describe the main findings in the text, and refer the reader to the tables and figures, implying that details are shown there. The formulations such as "It is shown in Table 1 that the outcome of Group A was better than that of Group B" should be replaced by "The outcome of Group A was better than that of Group B (Table 1)."

The need for brevity should not clash with the requirement that all results should be clearly presented.

Discussion/Conclusions

The discussion section should include interpretation of study findings in the context of other studies reported in the literature. This section has three main functions:

a. assessment of the results for their validity with respect to the hypothesis, relevance of methods, and significance of differences observed;

b. comparison with the other findings presented in the relevant literature; and

c. assessment of the outcome's significance for further research.

Do not recapitulate your results, discuss them!

6.2.2.3. Tables

Information on significance and other statistical data should preferably be given in the tables and figures. Tables should not contain only statistical test results. Statistical significances should be shown along with the data in the text, as well as in tables and figures.

Tables should bear Arabic numerals. Each table should be put on a separate page. Each table should be self-explanatory, with an adequate title (clearly suggesting the contents), and logical presentation of data. The title should preferably include

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the main results shown in the table. Use tables in order to present the exact values of the data that cannot be summarized in a few sentences in the text.

Avoid repetitive words in the columns: these should be abbreviated, and their explanations given in the footnotes. Present data either in a table or a figure.

Each column heading for numerical data given should include the unit of measurement applied to all the data under the heading. Choose suitable SI units.

Place explanatory matter in footnotes, not in the heading.

Explain in footnotes all nonstandard abbreviations that are used in each table.

6.2.2.4. Figures

Figures should be numbered in sequence with Arabic numerals. Legends to figures should be listed on a separate page, in consecutive order. Minimum resolution for all types of graphics is 300 dpi and 600 dpi is recommended. The legend of a figure should contain the following information:

a. the word "Figure", followed by its respective number;
b. figure title containing major finding (e.g. Manuscripts which follow Guidelines for Authors had higher acceptance rate, and not Relationship with manuscripts style and their acceptance rate).

Use simple symbols, like closed and open circles, triangles and squares. Different types of connecting lines can be used. The meanings of symbols and lines should be defined in the legend.

Each axis should be labeled with a description of the variable it represents.

Only the first letter of the first word should be capitalized. The labeling should be parallel with the respective axis. All units should be expressed in SI units and parenthesized. Make liberal use of scale markings.

Graphs, charts, titles, and legends in accepted manuscripts will be edited according to ToMS style and standards prior to publication.

Preferred format for graphs or charts is xls. Graphs and charts saved as image (raster) files such as JPG, TIF, or GIF and imported or copied/pasted into Word or Power Point are not acceptable.

The resolution for photographic images should be at least 300 dpi, and minimum image width should be 6 cm. Please submit files in RGB format. For published manuscripts, image files will be posted online in their original RGB format, maintaining the full color of your original files. Note that we will still need to convert all RGB files to CMYK for printing on paper and color shifts may occur in conversion. You will not receive a CMYK proof. You can view an approximation of print results by converting to CMYK in Adobe® Photoshop® or Adobe® Illustrator®.

6.2.2.5. Authorship statement

All contributing authors must fill out and sign these statements and submit them to the Editorial Office. Accepted manuscripts will not be published until signed statements from all authors have been received.

6.2.2.6. Acknowledgments

Technical help, critical reviews of the manuscript and financial or other sponsorship may be acknowledged. Do not acknowledge paid services, e.g. professional translations into English.

6.2.2.7. References

References cited in the manuscript are listed in a separate section immediately following the text. The authors should verify all references. Usage of DOIs is mandatory.

Examples of citation in text:

It is well known fact (Strang and Nquyen, 1997; Antoniou, 2006) that FT is not an appropriate tool for analyzing nonstationary signals since it loses information about time domain.

First group of authors (Vetterli and Gall, 1989) proposed Multiresolution Signal Analysis (MRA) technique or pyramidal algorithm. Second group (Crochiere et al., 1975; Crochiere and Sambur, 1977) proposed subband coding algorithm. Legal acts are cited as in example: The Constitution of the Republic of Croatia (Constitution of the Republic of Croatia, 2010) is the main legal source for this subject matter, as well as any other subject matter relating to the Croatian legal system. References from the Web are cited in the text as (Author(s) last name, year of origin if known (year of accessed in other cases). If the author is unknown, such as in case of company web page, instead of author's name, title of the web page is used.

Examples for reference section:

Journals

Petrinović, R., Wolff, V. S., Mandić, N. and Plančić, B., (2013), International Convention on the Removal of Wrecks, 2007. – a New Contribution to the Safety of Navigation and Marine Environment Protection, Transaction on Maritime Science, 2(1), pp. 49-55., https://doi.org/10.7225/toms.v02.n01.007

Pennec, E. and Mallat, S., (2005), Sparse Geometric Image Representations with Bandelets, IEEE Transactions on Image Processing, 14(4), pp. 423 – 438., https://doi.org/10.1109/TIP.2005.843753

Web links

Donoho, D., Duncan, M. R., Huo, X. and Levi, O., (1999), Wavelab, available at: http://www.stat.stanford.edu /_wavelab/, [accessed 12 August 2011.].

Unknown, Wavelab, available at: http://www.stat.stanford.edu /_wavelab/, [accessed 12 August 2011.].

ToMS home page, available at: http://www.toms.com.hr, [accessed 12 July 2012.].

https://doi.org/10.24355/dbbs.084-201905101325-0

Books

Mallat, S., (2009), A Wavelet Tour of Signal Processing, 3rd Edition, New York: Academic Press.

Chapter in book

Hymes, D. H., (1972), On Communicative Competence, in: Pride, J. B. and Holmes, J. (eds), Sociolinguistics, Selected Readings, pp. 269-293. (Part 1 if exists), Harmondsworth: Penguin.

Šoda, J., Beroš, S. M., Kuzmanić, I. and Vujović, I., (2013), Discontinuity Detection in the Vibration Signal of Turning Machines, in: Öchnser A. and Altenbach, H. (eds), Experimental and Numerical Investigation of Advanced Materials and Structures, Advanced Structured Materials (serial name if applicable), 41 (volume number if applicable), pp 27-54. (part if applicable), Heidelberg: Springer., https://doi.org/10.1007/978-3-319-00506-5_3

Conference proceedings

Łutowicz, M. and Lus , T., (2013), Effect of Loss of Cylinder Pressure Indicating Channel Patency on Parameters Values Obtained from Indicating Graph, Proc. 5th International Maritime Science Conference, Solin, Croatia, April 22 – 23, pp. 382-389., available at: http://www.pfst.hr/imsc/archive/2013/IMSC2013_proceedings.pdf

Kingsbury, N.G. and Magarey, J.F.A., (1997), Wavelet Transforms in Image Processing. Proc. First European Conference on Signal Analysis and Prediction, Prague, Czech Republic, June 24 – 27, Birkhauser, pp. 23 – 24., available at: http://www.sigproc.eng.cam.ac.uk/~ngk/publications/ngk97b.zip, [accessed 12 August 2011.].

Regulations, standards or legal acts:

Constitution of the Republic of Croatia, (2010), Narodne novine, 2010(76), pp. (if known).

6.2.2.8. Supplementary materials

Supplementary materials are optional. Authors can submit different types of materials which will be available on-line.

6.2.2.9. Language

Authors may use standard British or American spelling, but they must be consistent. The Editors retain the customary right to style and, if necessary, shorten texts accepted for publication.

This does not mean that we prefer short articles – actually, we do not limit their size - but rather a resection of the obviously redundant material.

The past tense is recommended in the Results Section.

Avoid using Latin terms; if necessary, they should be added in parentheses after the English terms. Real names rather than "levels" or "values" should refer to parameters with concrete units (e.g. concentration).

6.2.2.10. Abbreviations

Only standard abbreviations and symbols may be used without definition and may be used in the title or the page-heading title.

Non-standard abbreviations should not be used in the title or page-heading title. They must be explained in the text in the following way: the term should be written in full when it appears in the text for the first time, followed by the abbreviation in parentheses; from then on, only abbreviation is used in the text. This applies separately to the Abstract and the rest of the text.

6.2.3. Submission of manuscripts

Paper submission via ToMS web page Open Journal System.
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